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# VENOUS BLOOD TUMORS OF THE CRANIUM

In Communication with the Intra-Cranial  
Venous Circulation, Especially the  
Sinuses of the Dura Mater.

BY

WM. M. MASTIN, M.D.,  
OF MOBILE, ALA.



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Read in the Surgical Section, at the Thirty-Seventh Annual  
Meeting of the American Medical Association.

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*Reprinted from the Journal of the American Medical  
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## VENOUS BLOOD TUMORS OF THE CRANIUM

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Circulation, Especially the Sinuses of  
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Since the discussion of the subject of cranial venous blood tumors communicating with the cerebral circulation, particularly through the medium of the dural sinuses, in an article which appeared in the April and May issues of the *Annals of Surgery* for 1885, I have succeeded in collecting so much additional data relative to this important pathological formation, that I have decided to embody the results of my entire research in a second and more complete monograph.

This has seemed proper and desirable not only from the natural surgical interest which must attend all investigations and compilations leading to the clearer elucidation of an affection which, in both actual occurrence and literary records, constitutes a class of comparatively rare lesions, but also on account of the necessity of a very material change in some of the conclusions and deductions arrived at in my preceding brochure, which this increased information now renders obligatory. It is to this enlarged and more comprehensive examination of the subject that I desire to invite your attention.

With the simple explanation just made I shall not attempt to apologize for the numerous repetitions and dry details, especially in the references to clinical histories, which compose a certain part of these remarks, and will remain content in the belief that the topic possesses attraction equally great for others as for myself.



The infrequency of all reference to this interesting and uncommon form of sanguineous tumor in recent or modern surgical treatises, is a matter of considerable surprise and comment. Notwithstanding the occasional mention of the lesion, with the moderate number of clinical records which are to be found scattered here and there throughout the broad field of surgical literature, to say nothing of the manifest inherent importance of the formation, together with its relation to general surgery, I am unacquainted with more than a half-dozen works, among the vast profusion of surgical writings which have appeared subsequent to twenty years ago, that make the slightest allusion to the subject,—and especially does this observation obtain of American and English publications.

As representing the most prominent among those authors referring to the malady within this period, may be named MM. Follin and Duplay, who, in their admirable treatise on Pathology (*Traité Élémentaire de Pathologie Externe*, Paris, 1868-9), devote a short but concise and instructive section to a consideration of the subject; Legouest and Servier in their valuable article on the *Cranium* contained in the *Dictionnaire Encyclopédique des Sciences Médicales* (1<sup>re</sup> Série, Paris, 1879), contribute an important and comprehensive chapter on these sanguineous tumors; Bergmann (*Deutsche Chirurgie*, 1880); and Dr. Gross (*System of Surgery*, Phila., 1882), who notices the lesion in a brief paragraph, and without the addition of any special or original observations.

Prior to the date specified, however, surgical annals are not quite so barren of such allusions, as is amply indicated by the array of facts and clinical cases presently to be detailed, together with the bibliographical collection appended to this essay, and the most important of which are the contributions of Burns, Demme, Dupont, Stromeyer, Duplay, Verneuil, Jules Dubois, Middeldorpf, Burchard, Dufour,

Hecker, Michaud, Chassaignac, Melchiori, Azam, and Hutin, to which publications we are largely indebted for much of the knowledge that we possess concerning these types of cranial blood-tumors.

It is of interest to note, also, the various appellations given to the affection,—among other less distinctive terms, it being described under the several designations of: *Varix verus cirsoideus* and *varix verus circumscriptus*; *fistule osteo-vasculaire*; *erectile tumors of the skull communicating with the superior longitudinal sinus*; *sinus pericranii*; *varix sinus verus extra-cranium congenitalis*; “*venous tumors*” of the cranial bones; *varix spurius circumscriptus venæ diploicæ frontalis*; *sanguineous tumors of the vault of the cranium in communication with the intra-cranial venous circulation*; *sanguineous herniæ of the vault of the skull by communication, through openings in the bone, of the meningeal vessels with the exterior integument*; *varicose veins or venous varicosities of the skull*; *a new form of tumor of the vault of the cranium, produced by the blood in communication with the intra-cranial venous circulation*; *extra-cranial venous tumors connecting with the intra-cranial venous circulation*; *subpericranial venous tumors*; and *reducible sanguineous tumors of the vault of the cranium*. These titles were based upon some salient or distinguishing feature, and, at the same time, they furnish a fair insight into the individual opinions entertained of the pathology and origin of these formations by the authors respectively adopting them.

Recognizing the scattered and, under existing circumstances, often inaccessible condition of the literature, it has seemed particularly desirable that some attempt be made to gather these fragments together. Therefore, having succeeded in collecting a sufficient, if not the larger, portion of these fugitive contributions, from which, it is believed, some intelligent and decided inferences can be drawn, or, at least, enough to allow generalization, I shall endeavor in this sec-

ond article to lay the collated material before the profession in a more compact and tangible form.

*Classification.*—Considering all the pathologico-anatomical facts, combined with the various hypotheses relative to the subject, to which I shall advert hereafter, these tumors should be divided, on account of the period and method of their formation, into the following classes:

- I. Congenital.
- II. Spontaneous.
- III. Traumatic, or cases resulting from *direct* traumatism.

It appears warrantable, also, both from the etiology and special structures involved in each, to make two divisions of these three classes or groups, namely:

- 1. The Simple or Diffused.
- 2. The Venous or Vascular.
  - 1. The *simple* or *diffused* comprises those cases in which the blood effusion takes place immediately beneath one or all of the scalp layers—dissecting up these tissues and thus forming the tumor-walls—and which may be caused by spontaneous or other perforation of the cranial parietes with opening into the sinus, as in rarefying osteitis, and from many traumatisms.
  - 2. The second division, the *venous* or *vascular*, covers those cases formed through direct implication of or morbid action in the venous coats—the walls of a sinus, an emissary vessel, or diploë vein—as in ectasia of the sinus wall through a normal or abnormal skull perforation, in circumscribed and multiple varicosities and dilatations of the venæ emissaria, in ruptures of these emissary veins, and in dilatations of the diploic vessels with loss of osseous substance.

These two divisions again admit of still another division, dependent upon the particular features of the tumor, that is:

- 1. The cyst or pouch variety, which may be further subdivided into:



- (a) Fusiform,
- (b) Sacciform,
- (c) False, and
- 2. The varicose or erectile variety.<sup>1</sup>

1. The *cyst* or *pouch* variety is that form of the lesion which is characterized by the formation of a simple (seldom more than one) cyst or cavity; and therefore includes circumscribed dilatation of a vena emissarium (fusiform); an ectasia or hernia of a sinus, and dilatation of a diploic vessel (sacciform); perforation of the skull and sinus followed by immediate extravasation of blood beneath one or more of the scalp layers, and rupture of an emissary vein (false).

2. The *varicose* or *erectile* variety is composed of tortuous and varicose veins—principally the emissaria Santorini—in fine or gross bundles, bound together by connective tissue; and, occasionally, of a structure resembling true erectile or cavernous tissue.

Each of these several divisions and varieties will receive additional consideration in the subsequent pages.

#### CLINICAL RECORDS,<sup>2</sup> WITH COMMENTS.

A separate review of every individual case of the number collected, although requiring what would appear to be a needless detail and repetition, is really essential in an extended examination of this lesion, especially because of the several varieties of venous blood tumors communicating with the intracranial circulation, each of which appears to demand liberal illustration. It shall be my endeavor, however, to make this notice as brief and condensed as

<sup>1</sup> The varicose or erectile variety is not so distinctive of this class of tumors as the other forms, since it is very closely allied to the simple or superficial subcutaneous venous erectile tumor of the scalp.

<sup>2</sup> For several of these references I must acknowledge my indebtedness to Dr. William Browning, of New York, who very kindly directed my attention to them after the publication of my first paper.

the proper and connected presentation of the histories will permit, with a correct appreciation of the different salient and distinctive points which they offer.

#### I. CONGENITAL CLASS.

The earliest record of any case belonging to the congenital group which has come to my knowledge, is that occurring in the practice of Moreau, and related by M. Pelletan (*Clinique Chirurgicale*, t. II, p. 76, Paris, 1810) as follows:

A youth, 15 years of age, had located on upper part of forehead a congenital swelling the size of a pigeon-egg. It became larger and also of a bluish color when he stooped over the table at work, but in the morning upon first awakening it was much smaller and without discoloration.

M. Moreau divided the tumor centrally, and packed the profusely bleeding wound with lint, but this failing to arrest the hæmorrhage, the surface of the wound was painted with butter of antimony, requiring very many of these cauterizations to control the escape of blood. Now, however, high fever, headache, convulsion, and paralysis of the corresponding half of the body followed, and finally death ensued on the fourth day.

At the post-mortem examination were found three holes in the frontal bone through which enlarged and dilated veins passed on into the superior longitudinal sinus, thus placing the external varicose swelling in communication with the intra-cranial venous circulation. For a large area around these perforations the dura mater was inflamed and covered with pus.

Bruns, who also details this observation in full, speaks of it under the heading of *varix verus cirsoideus*.

The next case in point of date is that mentioned by Busch<sup>2</sup> in *Heidelberger Klinische Annalen*, t. 11, p. 249, 1826:

<sup>2</sup> Reported also in my previous paper.

During the accouchement of a patient, after the discharge of the waters (which were thick, greenish and fetid), and whilst head still at superior strait, a large, fluctuating tumor was distinguished on the child's head. The child was still-born; male; weight seven lbs.; skin detached and macerated, and limbs flaccid, showing conclusively that death had taken place some time prior to labor.

On the head there was a rather large, fluctuating tumor, of bluish color, which in length extended from the external occipital protuberance to middle of the saggital suture, and in the other direction from the point of ossification of one parietal bone to corresponding point on the opposite side, and projected the most in the region of the small fontanelle. All the cranial bones were very mobile, and that which deserves especial note, from an etiological point of view, was the absence of a defined and prominent ring around the border of the tumor. The tumor was opened by a long transverse incision, extending from right to left, which discharged a quantity of dark-colored, viscous blood, of an offensive odor. About two ounces was collected. This fluid was situated between the bones of the skull and the pericranium, and a careful examination of the line of incision showed that several vessels extending across the superior longitudinal sinus had been divided, and that the sinus was in communication with the tumor. The cranial aponeurosis over the site of the small fontanelle was thick and soft—being infiltrated with a gelatinous lymph—this thickness becoming less as the borders of the tumor were approached. This thickness, also, was easily distinguishable from an ordinary tumor of the head. There was no extravasation either in the brain or dura mater, although the cerebral vessels were engorged with blood.

It should be remarked that in Pigne's account of this case of Busch's the lesion is regarded of traumatic origin, being due to the traction and pressure

of the forceps employed in the delivery. But this, evidently, is erroneous, for the description given by Busch is so clear and explicit on this point that the intra-uterine death of the child, several days previous to time of labor, is not to be questioned; and hence I must consider the case as one of congenital formation. Dupont also regards it as congenital.

M. Chassaignac (*Thèse sur les tumeurs de la voûte du Crâne*, p. 125, 1848) mentions having heard Professor P. Bérard (senior) relate, during a course of lectures on anatomy, delivered in 1831 or 1832, the history of an infant in whom there was a varicose dilatation communicating with the superior longitudinal sinus, and which swelled considerably when the child cried or made any exertion.

This is a simple statement without any careful or decided clinical details, and nothing to indicate its manner of communication with the intra-cranial circulation; but there seems to be no reasonable doubt of its being congenital in formation, and composed, probably, of varicose venæ emissaria.

The case of Flint is thus briefly given by Pigné, Chassaignac, Dupont, and others:

There was found in the occipital region of an infant, several days old, a tumor of considerable size. He opened it. It contained venous blood, which flowed out in such quantities that the infant speedily perished from hæmorrhage. Examination showed this tumor to communicate with the longitudinal sinus.

From the symptoms presented, and in the absence of contradictory data, this case may be regarded as an ectasia or hernia of the sinus through the posterior fontanelle.

Mersemann records (*Observateur Médical Belge*, 1834) an example of considerable interest. Bruns also mentions this case, and includes with it that of Moreau's under the head of varix verus cirsoideus, as before referred to:



At birth a well-formed child had over posterior fontanelle a swelling the size of a pigeon egg, which in the course of six weeks had increased to three times that size. The pedicle was almost as large as the swelling itself; the skin covering it was thickened and wrinkled, although through it could be felt the fontanelle and edges of parietal and occipital bones. The tumor was uneven; no pulsation; color and temperature normal; but it became tense and bluish or even blackish blue when child made any exertion whereby the blood return from head was interrupted, but not increased in size. Palliation being useless, as the growth continued to increase, and as the mother insisted upon its removal, strangulation of the tumor was undertaken. Hence, whilst child was at the breast, a ligature the thickness of a writing quill was adjusted about the base. Upon the first tightening the child screamed lustily and struggled with hands and feet, but as soon as it was fully tied the infant became quiet, sucked, and fell asleep without indicating further pain. Next day child equally well—the swelling remaining same in size and color. On third day the strangulation had increased without any bad effect, the surface being cold and bluish, with fetid discharge from around the ligature. By the fourteenth day, after repeated tightenings of the ligature, the pedicle was reduced to size of a swan's quill, and, after applying a second ligature thereto, the tumor was ablated without a drop of hemorrhage. There was now left a simple sore, of good appearance, at base of which the fontanelle could be felt, and in three days more the second ligature separated and the ulcer healed. On opening the tumor there was disclosed a mass of areolar tissue containing a bunch of greatly thickened veins in which were several spherical enlargements (dilata-tions). The scalp was quite thick, but beginning to shrink.

Stromeyer (Ueber Sinus Pericranii, *Deutsche Kti-*

*nik*, Bd. 11, S. 160; April 13, 1850) reports a case observed by Francke. This is classed by Bruns under the title of *varix verus circumscriptus*:

Christian Brandt, a soldier, native of Wewelsfleth, 20 years old, was born with a swelling over left eye, for the dissipation of which medical aid was unavailing. This swelling, according to report, is now, proportionately, of same dimensions as in early life; extends from the glabella two inches to the left, and from the arcus supercilii to three lines above hair margin, covering about four inches square, and when distended is elevated about one inch. When patient is at rest the swelling does not stand out, but exertion, stooping, coughing, sneezing, compression of jugulars, warmth, and all conditions causing the blood to flow to head, or preventing its return, cause the swelling to fill, become tense, and elastic like a distended gland-abscess. When flaccid the skin feels like the walls of a completely emptied abscess. On outer edge of arcus supercilii is felt, through the swelling, a depression in frontal bone, and in this depression towards the external side there exists, apparently, a pretty large foramen. The length of depression is three inches, breadth one and a half to three lines. No pain except when he wears a heavy head-gear, or when making great exertion, under which circumstances there arises swimming of head and a feeling as if tumor would burst. Color of skin unchanged, even under maximum distension. Easily emptied by pressure, and refills in one-half minute. When distended the tumor is equally elastic over entire surface, and clearly outlined. Curative treatment not employed because considered useless and dangerous.

M. Verneuil presented, for M. Michaud, of Louvain, to the Société de Chirurgie, a pathologico-anatomical specimen with this history (*Tumeurs Erectile du Crâne Communiquant avec le Sinus*

longitudinal Supérieur. *L'Union Médicale*, 8 Février, 11 Série, t. 1, p. 254, 1859):

A young man 28 years old with an erectile tumor of superior eyelid. This swelling was without bruit or pulsation; its volume augmented upon compression of jugular vein or when patient stoops forward, but diminishes when head is erect. It is irreducible, and does not present characters pointing to communication with interior of skull; patient experiences sharp pains in tumor, and vision cut off by drooping of lid. Congenital in origin. Operation by cauterization with red-hot iron applied to three points. No trouble at first, but on seventeenth day patient seized with facial erysipelas, which was epidemic, followed by meningitis and death. A few days after operation the patient announced that he had another similar tumor on his head. This presented exactly same characteristics as first one. At the autopsy each tumor showed a cavernous tissue like ordinary erectile tumors; under them the bone was perforated by a multitude of little apertures which gave passage to the vessels penetrating into the interior of skull, thus putting each tumor into communication with the superior longitudinal sinus.

Middeldorpf gives the the history of the subjoined case<sup>4</sup> in a private letter to M. Dupont (*Essai sur un Nouveau genre de tumeurs de la voûte du Crâne formées par du sang en Communication avec la Circulation Veineuse intra-Crânienne*, p. 26, Paris, 1858):

Matilda H., æt. 9 years, daughter of a peasant living at Carlowitz, near Breslau; well nourished and developed. From birth there existed on her forehead, a little to left of median line, a tumor covered by the hairy scalp. It is round, smooth, and does not pulsate. Shortly after birth it was the size of a cherry, but now (1851) it presents a diameter of an inch and a half, and one-quarter inch thick. Offers different degrees of tension—one time flaccid, and

<sup>4</sup> Reported also in my previous paper.

then again much distended, but there is always a little fluctuation. Bending the head forwards toward the ground, etc., causes it to swell up; deep inspirations make it sink slightly; it quickly and without difficulty disappears under continued pressure, and this does not produce the least symptom of cerebral compression. After reduction the base of the tumor is found to be circumscribed by an edge or ridge three quarters of a line deep, denticulated, and which felt to be bony by the exploring needle. The base or floor of the tumor is formed by the cranial vault, almost flat, and without the sensation of any opening penetrating it, and is covered seemingly by a thin membrane. There are no cords or filaments to be felt in the tumor cavity except near the skin and hair line, where an ovoid cartilaginous button is perceptible, which is movable and about size of a grain of rice.

In 1856, at my clinic, I examined this tumor a second time, but, with the exception of being a little larger, it presented the same symptoms; the girl, also, continuing in good health. Pressure upon the tumor, after encircling it with an ivory ring which closely fitted its base, and pressing the ring down sufficiently to cut off the skin circulation, also causes it to disappear, thus demonstrating conclusively that the blood flows from the direction of the osseous base, and not from circumference vessels.

In the *Bulletin de la Société de Chirurgie* (t. iv, p. 414, *et suiv.*) M. Verneuil reports the following case<sup>6</sup> of this malady:

A young girl, aged 17 years, of a strong constitution and good health, presented herself to me, in 1854, for advice concerning a tumor on the forehead which had existed from infancy. She had some indefinite recollection of a blow received in early life, but it was entirely too vague to be relied on. No evidence of hereditary trouble in any of the family, and the tumor is, evidently, of congenital origin.

<sup>6</sup> Reported also in my previous paper.



The symptoms are as follows: Fluctuating, soft, and round; painless; ordinarily it is of the volume of a large nut when she leans forward, and is situated on the right frontal protuberance. The skull is unaltered in consistency or color, and no vascularity of the surrounding parts. Pressure causes it to sink and disappear entirely, and after reduction one can definitely determine that there is no appreciable alteration of the bone, and only a little circular ridge around it (its limiting boundary) is perceptible. This is rather resistant. The tumor is easily reduced by pressure, which must be steadily applied, and by this manipulation the sensation of a pouch partially filled with fluid, which empties itself, is experienced. The tumor bulges out under the influence of exertion and emotions, but there is neither bruit nor pulsation; and, again, cough does not affect it. When the head is lowered the tumor becomes voluminous, with the dimensions of 3 cm. in diameter by 1 cm. deep. In the dorsal decubitus the tumor attains a very large size, but it is largest when she sits in the sewing position with the head inclining forward. During the menstrual epochs, however, the tumor assumes, perhaps, its greatest volume, and at these periods she suffers from decided headache, but to this she is, at any rate, subject.

Later a cure took place, or, at least, the tumor subsided after a very prolonged examination with repeated palpations to which she was subjected at the Surgical Society.

M. Verneuil announces the favorable termination of this case with caution and reserve, because of his inability to verify the permanence of the cure by another examination at a more remote date; as, immediately after the subsidence of the swelling, she disappeared, and was not again seen.

Case of M. Foucteau (Note pour servir à l'histoire des Kystes des Enfants Nouveau-nés; *Gazette Méd-*

*icale de Paris*, Novembre 2, 111 Série, t. xvi, page 695, 1861):

A congenital tumor of the cranium, pediculated, situated over the posterior fontanelle. It was of a blackish color, fluctuating, and was divided by a vertical furrow into two unequal lobes. Greatest diameter was transverse; circumference measured around largest part 0<sup>m</sup>, 40, and at smallest part, 0<sup>m</sup>, 30; pedicle was 0<sup>m</sup>, 12. The pedicle was strangulated by a thread, and tumor punctured in right half, from which 300 grammes of a serous liquid flowed out, but only the right half was emptied thereby. Another puncture in left side gave exit to about an equal quantity of a sanguinous fluid. The pouch was not tardy in refilling, and by the following morning it had acquired about one half of its former volume; but at the same time the child was steadily sinking; lips and surface pale. Death followed. The autopsy demonstrated a communication between the superior longitudinal sinus large enough to admit the little finger. In the principal cavity floated a little accessory pouch, the orifice of which was distinct from the main tumor opening. On right wall of large cavity there existed another opening, of oval shape, with a sphincter-like edge, communicating with a third cyst. This is the cavity from which only the serum flowed. The pouches emptied after death furnished 255 grammes of blood, which, added to the 225 grammes extracted by the puncture, gives a mass of 480 grammes taken from the child in twenty-four hours, which is amply sufficient to explain its death. The pedicle was only incompletely strangulated. The little pouch in the middle was formed, apparently, of the vascular serous membrane. The two other compartments were lined with a very vascular serous membrane, easily detached from the skin by simple traction, and is continuous with the serous membrane of the cerebral sinus through the occipital fontanelle. This, then, is a blood-cyst formed by a hernia of the

serous membrane of the cerebral sinus through the unclosed posterior fontanelle.

Under the designation of Varix Sinus Verus Extra Cranium Congenitalis, Herman Demme describes elaborately in his excellent monograph, "Ueber Extracranielle mit den Sinus Durae Matris communicirende Blutcysten" (Illustrated, *Virchow's Archives*, Bd. 23, fol. 48, 1862), a marked example, of which the following is a condensation:

In February, 1861, I saw the infant son of W., a locksmith of Berne, nine months old, who was born with a swelling on the head, which had resisted all medical treatment. Other physicians had declared it cystic, and therefore benign, but the father was very uneasy on account of having previously lost a child with a very similar growth on back of head. Child's health is poor, and often in his sleep he cries out and carries hand to head as if in pain. Pressure upon the swelling always makes him restless. He is a pale, weakly boy, with rickety thorax and large abdomen. Head rather small, covered with thick blonde hair, and located thereon in middle of sagittal suture, is a swelling the size of a small apple. It is roundish, upper surface smooth, its outer covering being the scalp, somewhat pale, and sparingly covered with hair. No vessels visible; by transmitted light tumor is non-transparent; resistance equal in all portions; fluctuation in some places, with firmer masses in others. Continuous pressure gradually reduces swelling only in part on account of these firm masses—pressure, at the same time, causing face of child to become livid. Several large veins over upper eye-lid are distinct. Crying, and compression of jugular veins caused tumor to increase in volume and expansion and tension of walls, with a blue color. No essential connection with extra-cranial veins could be demonstrated, circular compression around base of tumor producing no apparent change. No arterial pulsation, though there was a feeble and

doubtful undulation movement. This was a synchronous rising and falling upon inspiration and expiration, which was more positively seen by the excursions of an exploring needle inserted therein; and auscultation discovered occasionally and irregularly a rustling and whirring sound. Withdrawal of needle was followed by a few drops of dark-red blood. Base broad and without pedicle or constriction; no appreciable alteration of bone surface, and hence no perforation of skull could be perceived. Electro-puncture would have been employed, but the instrument was not available, and hence non-interference advised.

May, 1861, death from cholera infantum. Autopsy: Body emaciated. The swelling, which is smaller (on account of absence of circulation), was incised lengthwise, discharging a dark bloody mass. Interior walls covered by different colored coagulum laminae, both firm and soft, as in an aneurismal sac. In the coagulum covering the base is a funnel-shaped depression into which a fine probe readily passes through an opening therein, for  $1\frac{1}{2}$  inches into the cranial cavity. Removing the cranial vault with the cyst and that portion of dura mater which is adherent to the bone, the brain is found to be anemic. The superior longitudinal sinus is distended and filled with coagulum, and is considerably dilated at point corresponding to the extra cranial cyst, and in which the point of the probe, introduced through the cyst, is plainly felt. In right wall of sinus near its base there is discovered a long oval spacious opening, through which the probe projects. Old blood clot, size of a pea, found in cerebellum. The external cyst-wall consists of the normal scalp; and a closer examination of the other layers forming its walls demonstrated seemingly the fact that it was formed by a hernia of the sinus walls through the osseous opening. The scalp moveable and easily raised, and pulling this forward showed that there was a hollow ped-



icle to the tumor connecting the sinus with the cyst cavity. The pericranium did not enter into the composition of the cyst coverings, but was intimately attached to the circumference of the bone opening and the pedicle. The bone was somewhat thinned throughout the space occupied by the tumor, more transparent and in a state of rarefaction. The walls of the superior longitudinal sinus were thickened, especially the fibrous elements, but otherwise little altered.

Demme also refers to a similar case, related by Bardeleben at a meeting of Naturalists, in Speyer. This was in the person of an adult in whom the cyst probably communicated with the sinus longitudinalis. In its treatment, Bardeleben successfully practiced electro-puncture.

Finally, the last instance which I have to mention in the Congenital group is that of Dr. Acland, of Oxford, which is contained in a paper entitled *Cases Illustrating the Formation of Morbid Growths, Deposits, Tumors, Cysts, etc., in Connection with the Brain and Spinal Cord, and their Investing Membranes*, by John W. Ogle, M.D. (*British and Foreign Medico-Chirurgical Review*, vol. xxxvi, p. 212, July, 1865):

*Case CXCVI.—Blood cyst beneath the Scalp, Communicating with the Torcular Herophili.*—The patient was a child, age three years, who died of chronic hydrocephalus.

*Post mortem.*—Cranium: At the posterior part of the cranium, beneath the integument, was a venous capsule communicating as described below, with the cranial cavity. The brain was greatly enlarged, and the anterior horn of one of the lateral ventricles was distended with serum. The occipital tuberosity was perforated by a foramen, through which a tube of fibrous tissue passed from the torcular herophili, admitting the blood into the subcutaneous venous capsule mentioned as existing at the back of the head.

The morbid preparation illustrating the above history is in the Pathological Department of the New Museum, at Oxford.

## II.—SPONTANEOUS CLASS.

The first example of the Spontaneous Class which claims recognition on the score of priority, is from a specimen belonging to the anatomist Jacobi (or Jakobi), and described by Beikert (or Beyckert) in his *Dissertat. De Nervis Duræ Matris. Argentorati, 1772*, S. 33; but concerning which all minute and descriptive data are wanting:

It was a case where a large swelling was located on the occiput, which was composed of a cyst filled with a coagulum. Close examination demonstrated the existence of a rather long hole in the os occipitis through which the superior longitudinal sinus protruded as a hernia under the scalp; and this, from the examination of the preparation, is, without doubt, the result of a secondary perforation, and not the congenital protruding of the sinus through a fontanelle.

Several authors refer to this example as an instance of congenital hernia of the sinus finding exit through the posterior fontanelle; but, as both Bruns and Demme (from the latter of whom I get my information, not being able to secure the original dissertation of Beikert's) claim a secondary origin, and, therefore, a probable non-traumatic perforation of the skull arising subsequent to birth, I have felt warranted in placing it in this division.

In the *Gazetta Medica di Milano*, Nro. 1, 1843, is found the subjoined case by Giovanni Melchiori:

In a girl, 14 years old, there was first discovered during an attack of fever with severe headache, a swelling on left side of head, beginning one inch above mastoid process and extending up to middle of parietal bosse. Transverse diameter below was 12 lines, above, 9 lines; thickness below, 8 lines,

above, 3 lines. Surface convex and smooth, but skin thinned in several localities, and of a transparent blue; base not movable; temperature normal; not sensitive to touch; consistency uniformly soft. Patient complains of a deep continued pain, accompanied by a pulsation extending into ear, but ceases when lower part of swelling is compressed. Later there was observed at lower third a simple rising and falling of the tumor synchronous with cardiac pulsations, with a blowing murmur. After death the swelling disappeared, there being in place thereof a network of empty veins, varying from the size of a thread to a pigeon quill, which intercommunicated freely, and finally ended in a common trunk the thickness of a goose quill. This passed through the galea aponeurotica capitis at lower and posterior edge of the parietal bone, piercing the bone, and finally opening into the transverse sinus, where it lies on inner surface of the temporal bone. There was meningitis, and all the cranial sinuses were filled with partially suppurating clots, although there was no disease of the sinus walls.

The following record of Hecker (*Varix Spurius Circumscriptus Venæ diploicæ frontalis*, etc. *Erfahrungen und Abhandlungen im Gebiete der Chirurgie und Augenheilkunde*, Ss. 151-155, with illustrations, Erlangen, 1845), especially illustrates the theory of slight traumatism in the production of osseous atrophy:

H. G., æt. 43 years; a factory hand; bileo-sanguineous temperament; of habitual good health, excepting several attacks of pneumonia; had on right side of forehead a distinctly fluctuating swelling, appearing gradually after certain movements and exertions, and which could be made to appear and disappear rapidly. It arose during the first year of life, after repeated blows received on head against a wooden floor in learning to walk. No effect resulted from remedies applied at that time. Notwithstanding the swelling increased with years the patient refused

medical aid, because he had become accustomed to the insignificant annoyance which it caused—there being not the slightest mental trouble. For many years it remained *in statu quo*. In 1834 he received a stab in tumor with a pitchfork. Severe hæmorrhage lasting for half an hour followed, but stopped spontaneously; and with the exception of remaining scar there resulted no inconvenience. When fully distended the skin covering becomes dark blue, with little spots of capillary enlargement over surface; it is also painless on pressure, somewhat tense, plainly fluctuating, and can be caused to disappear at once by light pressure of the hand. No bruit. Transverse diameter of the fully distended tumor is three and one-fourth inches; vertical diameter three inches; circumference at base eight inches; height two inches. It occupies almost entire right side of forehead, slightly encroaching upon left side, and consists of two parts, one within the other as it were, irregularly separated by a circular shallow depression; the larger or main tumor being size of an apple, and of blue color; the smaller is less prominent and of normal color, and gradually passes out into surrounding healthy skin. All movements interfering with return of venous blood from the head cause the growth to enlarge, as coughing, sneezing, straining, etc., but this enlargement is scarcely up to one half its capacity, and subsides on cessation of the effort. No effect produced by holding breath. It augments to greatest extent and most rapidly by forward and backward bending of head, deep and continued expiration, pressure upon neck, and especially compression of jugular veins. The filing of tumor by bending head forward is accomplished in two minutes; by pressure upon right jugular vein in one minute; and by pressure of both jugulars a little more rapidly. Although compression of left jugular causes the complete distension of the growth, yet only one-third of the tumor fills rapidly; and gener-



ally one-half of the tumor swells faster than the other, which is notably slower in distending. Expansion begins by undulating movements a half inch above orbital rim at the lower and sloping edge of tumor. Only when distension is complete does patient complain of sensation of tenseness and dizziness. If head is now brought erect or if deep inspiration is taken, the swelling disappears spontaneously in the space of a minute, thus subsiding twice as rapidly as it developed. Light pressure effects reduction in ten seconds, and when reduced the walls form a loose, bagging sac, which hangs down one-half inch over brow; and above is distinctly felt, occupying the right half of forehead, a crescentic depression with horns looking downward. A pulsating vessel is also felt, corresponding to the supra orbital artery, and which causes pulsation of empty sac. More careful examination also discloses a circular opening in external table, of the diameter of two and one-half inches, surrounded by a sharp osseous ring, but this absence of the outer table is not shown to be a complete perforation through the entire thickness of the skull. Therefore, just beneath the skin lies the diploic structure, on which is plainly felt numerous osseous projections from the size of a lentil to a pea, partly smooth and partly rough, together with depressions or real furrows—apparently the bony canals in which run the frontal diploic veins. About middle of this opening but nearer to supra-orbital ridge, there is a prominent osseous projection, in the point of which there is an apparent opening, and which is painful when roughly handled. Attempts at compression had no effect upon tumor. The growth is, therefore, a cutaneous blood-pouch which communicates by means of the frontal diploic veins with the intracranial venous circulation. Operative interference considered doubtful and hazardous.

Hecker employed this term of "*varix spurius circumscriptus venæ diploicæ frontalis*" on the sugges-

tion of Stromeier, who chose the appellation from the analogy which the lesion seemed to bear to circumscribed false aneurism. In a later work (*Deutsche Klinik*, Bd. 11, S. 160, April 13, 1850), however, Stromeier considers this title inappropriate, both on account of its length and the insufficient designation or description of the actual character of the growth which it conveys. Again, traumatism being, so evidently, a primary causative factor here, this case would appear to belong to the third or traumatic group; but it must be remembered that in the classification adopted, the traumatic class is composed alone of cases resulting from direct cranial fracture or suture separation.

The following, which is the case<sup>6</sup> of MM. Nélaton and Richard, was presented by Richard to the Société de Chirurgie, Oct. 1, 1856; and was afterwards examined and fully and carefully reported by Dupont (op. cit., p. 28):

B., laundress, æt. 19; moderate stature and strength; chestnut hair; born at Signier (Mauche); admitted Sept. 22, 1856, to l'Hôpital des Cliniques, bed 4 of woman's pavilion, during the time that M. Richard had charge of the service of M. Nélaton, in the absence of the latter.

No hereditary trouble in either herself or family. No serious attack of illness except one when 4 or 5 years of age, and and which was evidently some 'sweating fever.' In 1848, when 11 years old, she was seized with a violent throbbing frontal headache, which deprived her of sleep and lasted her the entire night. The day following, the pain still present, and greatly augmented when she assumed the recumbent posture. In arranging her hair on this day she lowered her head, and in so doing discovered that there was a soft point on top of head as large as a five-franc piece. In reply to questions, her mother informed her that it had existed ever since her sick-

<sup>6</sup> Reported in my previous paper.

ness at the age above mentioned, at which date she first discovered it. Thus it is probably of congenital origin. She is subject to headaches, but which are uninfluenced by the menstrual epochs. Tumor has been increasing since 1853.

Examination now presents the following characters: It is situated at the summit of occipital region over saggital suture, at superior angle of the occipital. When head is erect tumor is not visible, and no projection evident to the touch, but when head is carried forward or backward the tumor immediately appears, and is globular and voluminous, with a base of  $6\frac{1}{2}$  to 7 cm. in diameter. Uninfluenced by cough or respiration; but any exertion causes it to rise and become apparent, but again subsides on cessation of effort. It is soft and fluctuating; no pulsation or bruit, and artificial reduction not followed by cephalic symptoms. Reduction easy; sensation that of a pouch full of liquid which is emptied steadily and rapidly. Compression of internal jugular veins, even when head is erect, causes a rapid filling of tumor. Circular compression, by string tied around the head, and the jugulars compressed, the tumor appears quickly and to full size. Border of tumor smooth and nearly regular. Palpation shows two or three depressions which might permit intra cranial communication; curvature of skull unaltered; coverings normal, and without edema or infiltration. Inconvenience complained of is vertigo, which is produced by stooping or any sudden or extended movements of head. Drowsiness followed manipulation of the tumor. Only treatment adopted was that which would control increase of the growth. Patient now lost sight of until December, 1857, when she stated that she had been pregnant and was then a mother. After accouchement she had an attack of facial erysipelas, accompanied by intense fever and delirium. She had taken no precautions to arrest progress of tumor, and hence it was now found to be modified.

These changes are: Increased in all diameters; surface of bone no longer normal in curvature, but is irregular, as if a chip of bone had been raised up from cranial vault, especially at anterior border. In the general depression the finger easily demonstrates four smaller depressions in the bone, two in the median line and one on each side of that line. The median depressions are thus disposed: The first is circular and placed immediately behind anterior border of the tumor, has a diameter of  $1\frac{1}{4}$  cm., and admits end of finger pulp. The second median depression is located  $1\frac{1}{2}$  cm. behind the first, and has a diameter of  $\frac{3}{4}$  cm. only. The left lateral depression is directed from before backward and from left to right, has the form of a cleft of less than  $\frac{1}{2}$  cm. in width by 1 cm. long; its posterior extremity extends to within 1 cm. of the median line and to 1 cm. behind first depression. The right lateral depression is on the same level with the left one, but it is circular and is less than  $\frac{1}{2}$  cm. in diameter. The anterior median depression has thus modified the external appearance of the tumor, which is now not regularly globular, but resembles the hilus of a kidney. Circular compression does not prevent filling of the tumor; and again closing the four osseous openings with the finger tips, and then inclining head forward, the tumor expanded with same rapidity, showing that there were other unrecognized communicating orifices in the bone.

January 24, 1858. Tumor now increased in size on its left side, at which locality a smaller tumor ( $1\frac{1}{2}$  cm. in diameter) had formed in connection with it, and communicated with the larger tumor.

This case of MM. Nélaton and Richard is considered by them of *probable* congenital formation, but a careful analysis of the history and symptoms given leaves no doubt of its spontaneous origin, and which was the result, in all probability, of a rarefying oste-

itis, due to some trivial blow, about the time of the serious attack of illness in her infancy.

Under the subdivision of "Varix Verus Circumscriptus," already alluded to, Victor Bruns (*Handbuch der Praktischen Chirurgie für Ärzte und Wundärzte*, Bd. 1, Abth. 1, S. 191, with atlas of illustrations, Tübingen, 1854), mentions an example met with in his own practice:

A farmer, 36 years old, has observed for the last three years the gradual formation of a swelling on the forehead to left of median line, which is alternately larger and smaller, and sometimes even disappears. He can trace it to no cause. It is entirely painless, firmly located near the middle line in the course of the left frontal vein, which latter, when filled, together with its bifurcation over the swelling, is plainly visible. The tumor is of size of one-half of a hen egg; becomes filled and distended when stooping, as, also, under all conditions interfering with return of venous blood flow from the head; can be instantly reduced by light pressure by the fingers, and when reduced there is distinguished in its site a perceptible depression in the cranium, which on right side is bordered by a padded osseous rim. Pressure upon the venæ frontales below the swelling does not cause its distension, neither does pressure from above prevent tumor from being emptied. (Vide fig. 13, Abth. 1, Taf. iii, of Atlas.)

In conjunction with this case Bruns details a second instance; but careful examination of this latter one shows it to be simply a cutaneous venous varix with no indication of intra-cranial communication, hence I do not consider it is entitled to occupy a place among the present order of tumors.

In 1855 Dr. John S. Andrews reported a case of "Tubercular Encephalitis with Pulsating Tumor on the Occiput" (*New York Journal of Medicine*, new series, vol. xv, pp. 356-361, November, 1855):

Lamartine Bovay, born in 1848, of healthy pa-



rents. Birth natural and head unusually symmetrical. Mind always active and very bright. Up to age of ten months he was very well, but at that date an eruption, following vaccination, appeared on his face and spread over surface; and as this subsided, dysentery ensued, followed by some pulmonary complication, which, in turn, was followed by glandular enlargements of neck and soreness behind ears, lasting several months. In the ensuing February he was attacked with a so called intermittent neuralgia, characterized by severe occipital pain, stiffness of neck, and fever, which continued for three weeks. Similar attacks followed up to 1854, when some lung affection again manifested itself. This subsiding, the neuralgic symptoms again appeared, and were severe and erratic. The finale of this was the appearance of a pulsating tumor on back of head, attended by a gradual loss of sight in left eye. Under treatment, lasting from May to September, his health improved, the tumor disappeared, but no visual change. He remained in tolerable health, except headaches caused by excitement, etc., until May 7, 1855, when another neuralgic attack appeared with same previous symptoms; and about the fourteenth day of this seizure there was slight unconsciousness. He now was extremely prostrated, suffering agonizing pain in back and left portion of head. Veins of head full and enlarged, eyelids closed, pupils sensitive to light but eyes amaurotic. Hyperesthesia. There was an indentation in occipital bone where tumor had appeared. A few days later tetanic convulsions, lasting several hours, supervened, and shortly thereafter the tumor again appeared, and he died five days later by increasing coma.

*Autopsy*—eighteen hours after death. On detaching scalp a number of large distended veins were observed about middle of occipital bone. Just below the external occipital protuberance was found a depression about one third inch in diameter and one-

fourth inch in depth. This was the location of the pulsating tumor, and corresponds with the intra cranial part known as the *torticular Herophili*. Covering this depression in the bone was a membrane which appeared to be formed of the thickened walls of a distended vein, and on incising it venous blood freely escaped. This opening proved to be a complete foramen piercing the bone, about size of a crow-quill, and there was no doubt a free communication between the sinuses of the brain and the enlarged external vein. Brain showed tubercular deposits, effusion in membrane cavities and ventricles, in a word, tubercular encephalitis.

At a meeting of the Surgical Society, held Nov. 23, 1859, M. Verneuil reported the following case in behalf of M. le docteur Jules Dubois, Médecin Adjoint de l'Hôtel Dieu d' Abbeville (*Bulletin de la Société de Chirurgie de Paris*, t. x, p. 238, 1859):

*Case of a Blood-Tumor of the Vault of the Cranium in Communication with the Longitudinal Sinus.*—B. (Jean) born at Guer (Morbihan) April 8, 1833, of fine constitution, habitual good health, and without syphilitic manifestations. Belongs to 9th regiment Chasseurs. On May 8, 1859, he applied to be relieved of a wen situated on forehead between eyebrows. An ovoid tumor, about size of a hazelnut, very mobile, soft and pliable to the touch, non fluctuating, of a slightly violaceous color, occupied the space comprised between the nasal eminence of frontal bone and border of true nasal bones on one side, and between root of brows on the other. No pulsation, no expansion, no rising, no venous varicosities in the vicinity. Light and moderate but continuous pressure caused complete disappearance of tumor, leaving nothing between the fingers but a little core-like substance about size of a lentil, soft and movable. A minute exploration after reduction discloses a thin pedicle which appears to spring from fronto nasal suture, but could not find any commu-

nicating opening or appreciable fissure. (Compression being removed (patient in upright posture), the tumor returned gradually to its primitive volume. Reclining on back caused tumor to be diminished four-fifths in circumference; but it augmented and became distended, on the contrary, when the head was inclined forward. Compression and reduction produces no trouble whatever. Interrogated as to the cause and formation of the growth, he said that about five years before he received a blow between the eyes from a stone violently hurled. There was no other symptom besides a thrombus, which disappeared by degrees, leaving, however, for quite a long time a slightly hard swelling, sensitive to pressure, with a heaviness of the head, but without pain. It was only at the beginning of this year (1859) that he felt for the first time a swelling which rolled under the skin. It was now of the volume of a pea, but increased gradually. It produced no trouble whatever, and his only desire to have it removed was on account of its unfortunate location. Accurate and well applied pressure with a roller bandage was totally insufficient, and had to be removed the following day. On May 17 he was sent to the Hôtel Dieu d'Abbeville, that my colleagues might see the case. He entered the service of Dr. Vésignié, who also tried continuous pressure by means of forceps applied directly to the tumor; but at the end of forty-eight hours the patient declared that he could stand it no longer; the skin was excoriated, and the tumor had pressed out on either side of the clamps, demonstrating the inefficiency, if not inutility, of such a method. June 18 he returned to his corps, and a few days thereafter I found that the coloration of the tumor was deeper, somewhat increased in volume, and especially that its reduction was not so easy—the dorsal decubitis having little influence over its volume. This was, evidently, the result of the forceps pressure and the handling, for, at the expiration

of a fortnight after being left undisturbed, the tumor presented all of its former characteristics. August 7.—The tumor has progressively augmented in size, now equaling a pigeon egg, skin more thinned, and of a deeper violet color, and from time to time he experiences severe frontal headache, with a benumbing of the senses; tumor turgescient and less reducible. My confrères at the hospital concurred in my diagnosis of a sanguineous tumor communicating more or less freely with one of the sinuses of the dura mater, probably the superior longitudinal sinus. The pouch was evidently not single, but it contained, as shown after complete reduction by pressure, an elastic substance or areolar tissue communicating by a narrow opening with the sinus.

A rarefying osteitis resulting from the contusion received five years prior to its appearance was, undoubtedly, the cause of this formation. No further treatment was employed, because considered either useless or harmful.

In the *Gazette des Hôpitaux*, October 14, 1856, Baron H. Larrey reports this case:\*

Val de Grâce, ward 29, No. 10.—O. (Antoine), musketeer of the 8th Line; æt. 23. Entered in September, 1856, with a varicose frontal tumor, the base of which, almost circular, was the size of a five franc piece, situated on forehead above left eye, partly within and partly below the hair. He has no recollection of ever having sustained any blow or injury about the head, and he had not perceived its presence until one day, at the age of 11 years, his mother noticed the swelling on his forehead. He was superficially examined by the Army Examining Board, accused of possessing voluntary control over swelling, and declared fit for service but trial showed that it was impossible for him to wear the shako. At present the tumor is found slightly elevated above the skin-level when patient is reclining, or even standing,

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\* Reported in my previous paper.

but it promptly increases in size when the head is lowered. There are a few ill defined deep blue spots on its surface; it is soft, but gives no sensation of pulsation. When sufficiently depressed to feel the bone beneath there is discovered an irregular or stellated perforation of the cranium, and only its shape prevents the easy introduction of the finger therein. Compression causes no pain in tumor itself, but does produce a little pain, with mistiness of vision, in the eye of affected side. Slight symptoms of cerebral compression are produced by pressure upon the tumor. The day of admission to the hospital, after a rather prolonged examination, he was seized with marked vertigo, accompanied by vomiting, diarrhea, etc. He was declared unfit for military service, and consequently discharged.

At the meeting of the Société de Chirurgie, Paris, October 1, 1856, Middelдорpf referred very briefly to the case of a young girl in whom such a tumor was situated high up in the median line of the occiput, and emptied into the superior longitudinal sinus. This patient was also mentioned by him in a personal letter to M. Dupont (*Op. cit.*, p. 26), in which he stated that, unfortunately, the clinical notes of the case had been mislaid, and hence he was unable to give, with any degree of certainty, from memory alone more than an outline of the case.

M. Giraldés, at the séance of July 27, 1864, of the Société de Chirurgie, briefly related the clinical points of this case (*Tumeur Vienneuse, Bulletin de la Société de Chirurgie de Paris, 2 Série, t. v., p. 357, 1864*):

He presented a child with tumor on frontal region. This growth seems to be formed by the superposition of two osseous fragments. Under the influence of effort, as, for example, blowing into the hands, the tumor swells up; but lightly applied pressure completely reduces it. The consistency is soft; the bending-over posture augments it; and puncture with a pin is followed by the escape of a little venous



blood. There is no pulsation. It communicates, probably, with the sinus of the dura. The tumor is of five years duration, and appeared after a fall on the forehead; other than this there is no assignable cause for its origin. A furrow is distinctly felt over the point occupied by the growth, and, the tumor being reduced, pressure by the fingers over this groove prevents its reproduction, notwithstanding those exertions, etc., on the part of the child which usually causes its increase in bulk.

In the discussion which followed the presentation of this case, some doubt was expressed as to the communication of the growth with the superior longitudinal sinus; but the final result was a full concurrence in the opinion of M. Giraldés as to the existence of intra-cranial association.

Again, the length of interval between the reception of the fall and the appearance of the growth is not given, but it is presumable that it did not appear immediately upon, or even a reasonably short time after, the infliction of the injury.

The next example is given by M. Simon Duplay (*Tumeur sanguine de la voute du crâne en communication avec la circulation Veineuse intra-crânienne. Archives Générales de Médecine*, vi Série, t. 29, p. 94, Janvier, 1877):

A young girl, moderately well-developed, enjoying habitual good health, and having menstruated regularly for the past eight months, presented herself to me at the Hôpital Saint Louis in the month of last August. She was born at term, and delivery of head natural and without interference. At the age of four years the child received a severe fall from the second story, which fractured the right clavicle, but the mother declares that the head was not struck and hence there was no injury to this part. Three years later, however, the child struck her head violently against a table, but the precise locality of the contusion could not be demonstrated. About two and a

half years after this second accident the mother discovered, in combing her hair, the existence of a small soft tumor, flattened, situated at the posterior superior angle of the right parietal bone, in vicinity of lambdoidal suture. During last seven or eight months this growth has developed quite considerably, becoming modified in form, and increasing in depth. After shaving the scalp the following particulars were demonstrated: On right side of cranium, in a line uniting the ears in passing over the vault of the skull, at about 10 cm. in front of occipital eminence, there exists a rather projecting tumor, very irregular in contour, with poorly defined limits, of a deep violaceous color, skin-covering thinned, and measuring about 1 cm. from before backwards, and 7 cm. transversely. It continues outwards and downwards on the temporal bone as a prolongation, having the appearance of a large varicose vein, slightly tortuous and bosselated, and, becoming greatly lessened in size, terminates in a *cul-de-sac* behind right mastoid eminence. Its entire length is about 2 cm. It is soft, non-resisting, fluctuating, easily depressed, and is incompletely reduced under the influence of very light pressure. The contents are evidently fluid, can be pressed out of the varicose prolongation and *vice versa*; and when the compression ceases the tumor and its prolongation gradually refill. Upon gentle palpation there is perceived a pulsation, very feeble, synchronous with the pulse. These are undulations rather than veritable pulsations, and there is no appreciable expansion. Again, careful and repeated examinations do not discover the existence of any of these vague pulsatile undulations in the varicose prolongation. These undulations, on the contrary, are greatest at the principal centre of the tumor. At the first examination there was heard by means of the stethoscope a faint whirring, intermittent bruit at the centre of tumor, but this could not be verified at subsequent examinations.

Inclining the head forward causes the tumor to augment in volume, becomes very hard, and the child complains of a vague sensation of pain in the head; and the same phenomena are produced with more intensity when the head is strongly bent backwards. The normal respiratory movements do not exercise any manifest influence in the volume and tension of the tumor, but these are slightly influenced by forced expiration with the nose and mouth closed. Upon pressure upon the prolongation, so as to press out its contents towards the principal tumor, causes it to disappear completely, and it is not reproduced upon exertion or forward inclination of the head whilst compression is maintained at its junction with the principal tumor. Whilst this prolongation is emptied in this manner gentle pressure upon the principal tumor by means of the hand easily effects its complete reduction. Circular compression by means of leaden strips, etc., demonstrates the non-connection of the growth with the vessels of the scalp. The cranial wall on which the prolongation rests seems to be absolutely normal. One is compelled to admit that the tumor communicates directly with the interior of the skull or the diploic veins. When complete reduction of the tumor is produced there is felt on the cranial surface a sort of irregularity, which feels like an opening, but this is not certain; however, it is seen that compression applied by two fingers to this locality which resembles an opening, absolutely prevents the refilling of the tumor. When reduction is complete the patient complains of a little pain in the head, but she experiences neither vertigo, giddiness, dazzling, nor roaring in the ears. The tumor is indolent. Active treatment not advised.

The point of notable interest in this case is the peculiar venous prolongation terminating in a *cul-de-sac* behind the mastoid process, and which simulates a tortuous vein. The undulatory movements syn-

chronous with the pulse beat were due, evidently, to transmitted cerebral pulsations.

The last observation, which completes the series of cases belonging to the spontaneous class, is that of C. H. Mastin, in my previous paper (*Annals of Surgery*, vol. i, No. 4, p. 326, 1885):

W. D. Penton applied for professional advice Sept. 10, 1881. He is a man 35 years of age, laborer, married, and the father of several children. His own health has always been good, and, with the exception of frequent dull headaches, is still excellent. In appearance, also, he is moderately robust and vigorous. There is no history or evidence of hereditary disease, nor is he cognizant of ever having sustained a severe fall, or any blow or wound about the head. When a youth he contracted a gonorrhœa, and also suffered from a venereal ulcer on the glans penis; but now the closest questioning and examination fail to discern the slightest indication of systemic infection. About five years ago he chanced to feel a small lump or wen like mass, equal in bulk to a common acorn, on the left and posterior portion of the scalp. This was painless, compressible, disappearing entirely on pressure, but partially redilating on removal of the compressing force, and gave so little trouble as to render its discovery the result of the merest accident. His attention being once called to the existence of the growth, frequent handling followed, and hence he is able to assert that the tumor gradually enlarged until it attained its present dimensions of a large chestnut, although he is equally assured it has remained *in statu quo* for the past eighteen months. As mentioned above, his only inconvenience is an harassing headache, which is fleeting in character—coming and going—and which he thinks is connected with the tumor, but he is unable to trace a positive or direct association therewith. He is confident, however, that the condition and size of the growth is materially influenced by a hearty meal, the recum-

bent and stooping postures with the head below the level of the remainder of the body, and after muscular exertion; under all of which circumstances it becomes full, tense, and decidedly augmented in volume.

A careful examination whilst sitting upright, now reveals only a slight fullness of the scalp in the locality indicated, which readily, though somewhat slowly, disappears upon lightly made pressure by the finger or hand, and leaves in its stead an indentation or depression in the skull, occupying the upper extremity of left arm of lambdoidal suture. This depression is quite perceptible, and is of a triangular funnel shape, being wide at margins (large enough to admit tip of index finger), and gradually narrowing down, apparently, to a single small aperture where it penetrates the bone and emerges into the cranial cavity. When the sac is evacuated by compression, the tegumentary covering is regular, lax, movable, and moderately thin, and through which the surface of the bone is felt to be smooth, and devoid of all perceptible irregularities or roughnesses. Reversing this position, and causing the patient to recline or stoop, with his head hanging down, a round, distinct tumor is found to rise and expand steadily over the site of the indentation. It is soft, elastic, conveying to the touch the sensation of an ordinary hæmatoma or blood-tumor of the scalp, not discolored, and is easily reducible, after the emptying of which the osseous depression is again perceived. Dizziness and vertigo result if this posture, with the head lowered, is maintained for a short time. Pressure causes neither pain nor the least uneasiness—cerebral or otherwise. There is no pulsation or bruit; no appreciable effect produced by the respiratory act; but I find that any interruption to the blood current through the jugulars increases the tension of the tumor. The surrounding integument is unimplicated, and there is no other lesion of the head. There is disturbed cardiac action,



but both heart and lungs are without organic disease. The ophthalmoscope shows the papilla and general fundus of both eyes to be normal, although vessels of the disc are rather small and narrow. Hearing normal. Operative interference deemed inexpedient, and hence only palliative measures of a protecting leathern pad and avoidance of excessive exertion was advised.

Here was conclusively an example due to a rarefying osteitis originating, in all likelihood, from the resorptive action of a Pacchionian granulation.

### III.—TRAUMATIC CLASS.

My researches in the traumatic group have been rewarded by the gathering together of several well authenticated and important records.

One of the most typical, as well as the earliest, instances, is that related by Percival Pott ("Chirurgical Works," first Amer. from last London edit., vol. i, p. 132, Phila., 1819; also French edition, t. 1, p. 151, 1760):

A boy, 8 years of age, son of a Jew merchant of this city, received a blow on his head with a stick. This made him giddy for a few minutes, but there was no bleeding, no external wound, and but little pain, and he concealed the fact of there being a swelling over that portion of his head until it was discovered by his barber. In the centre of the top of his head was a tumor almost the size of a walnut; indolent, had a dull kind of pulsation, and palpably contained fluid. In the presence of Serjeant Amyand and Mr. Shipton the tumor was divided with a knife and a quantity of blood discharged; but when the swelling was emptied it was found that the blood continued to flow, plainly not from the scalp wound, but from the bottom of the cavity. Examination now showed that the sagittal suture was fractured, and that a portion of the displaced fragment of bone

<sup>8</sup> Reported in previous paper.

was forced into the sinus, and by the sides of which the blood issued forth. Attempts to extract this fragment failed. By advice of the consultants, a small perforation was made on one side of the suture, but through this the point of the elevator could not be introduced so as to remove the broken piece, and so the trephine was applied on the other side of the suture, but with like result. At last it was decided to risk the hazard of wounding the sinus (which was, indeed, already wounded by the broken bone), and enclose the suture within the circle of the trephine. This was done, but the button of bone came away in pieces, and left the original perforating fragment still piercing the sinus. This fragment being withdrawn by means of forceps, a flux of blood followed, but a dossil of dry lint controlled it. The patient recovered.

There are very many cases similar, if not exactly analogous, to this case, to be found in surgical literature; and among the most striking of which are those mentioned by Guthrie (*Commentaries on Surgery*, etc., p. 349, Amer. ed.), and M. Mouton (*Mem. Royal Acad. Surg. of France*, Sydenham Edition, p. 8).

M. Azam (Dupont, *op. cit.*, p. 20) reports two cases of this accident which came under his observation, as follows:

C.,<sup>9</sup> age 22; miller, robust; entered the Hôpital Saint-André, service of M. Hirigoyen, Nov. 11, 1850. Situated on top of the frontal region, a little to the right of median line, was a tumor of the dimensions of a large nut. It was irregularly round, manifest fluctuation, but no discoloration of skin. Gentle pressure with the palm of the hand reduces it completely in two or three minutes, after which the skin remains empty and flaccid, and is also very thin and soft. Hence one can easily recognize an irregularly circular depression across it, with salient and

<sup>9</sup> Reported in my first article.

unequal edges. The patient reduces it easily himself, and it disappears when the head is thrown backward and reappears with the forward inclination. The forward posture cannot be maintained for any length of time on account of vertigo, which accompanies this position. No bruit or pulsation, but seems a little more tense during the respiratory movements. I have thought that I perceived an obscure blowing sound in the tract of the superior longitudinal sinus when tumor was rapidly reduced by the patient, but my confrères could not verify it. No pain, and were it not for the deformity with the vertigo whilst bending forward, he would not be inconvenienced by its presence.

As to its origin he reported that, at the age of 15 years old, he was kicked by a horse in the frontal region. Did not lose consciousness, and even continued to follow his occupation—it being several days thereafter before he discovered this tumor, which has always presented its present appearance. He had consulted another physician some time previously, who made an exploratory puncture, which was followed by a jet of blood. This was easily arrested. Nov. 20, M. Hirigoyen punctured it with a lancet. Blood spirted out, having all the characters of venous blood. A probe introduced now discovered a depression in the bone and some roughnesses, although the bone is not denuded, but covered by a thick, soft membrane. No orifice of communication with interior of skull is discoverable, but such must exist, and is probably with the superior longitudinal sinus. Haemorrhage easily controlled, and skin wound healed rapidly. Pressure over tumor was employed for twenty days without result, and the patient left the hospital in an unchanged condition. Saw him twice afterwards, the last time in 1857, and tumor in same condition. The avoidance of any operation, and the use of local pressure, was advised.

The next is the second case<sup>10</sup> of M. Azam (Dupont, loc. cit.):

Jeanne T., of the *Bourg-sur-Gironde*, age 60 years, consulted the 'Charity Committee' of the Medical Society of Bordeaux in March, 1854, about a tumor situated in the frontal region. She stated that about eighteen months previously, whilst at work in the field, she stepped upon a rake, which flying up, the end of the handle struck her with considerable force on the forehead. The pain was intense, but she did not lose consciousness. The apparent contusion was relieved by ordinary measures without medical attention. Twenty to twenty-five days afterwards she recognized the existence of a tumor at point of contusion. This was soft, size of a small nut, and hardened and increased in volume when she lowered her head. No headache. Did not consult a physician until after three months had elapsed, at which time the skin covering the tumor becoming thinner and of a violet color, she consulted M. Gaignerat, of Bourg, who punctured it, and, according to her statement, it bled most profusely, but a bit of English taffeta sufficed to staunch it. She presented herself now before the Medical Society. At this time the tumor, situated on the median frontal line, near hair margin, was about the size of the half of an ordinary nut; soft and fluctuating; slightly violaceous in color; without pulsation or bruit, and conveying the sensation of a skin pouch containing a spongy substance. It becomes tense when the head is bowed down or lowered, and a continuance of this position causes dizziness. It softens and slowly diminishes under pressure by the hand or fingers. It is very evident that the fluid passes into the skull. After reduction of tumor there remains under the skin a soft tissue which prevents any close examination of the underlying bone. Punctured it with a small trocar; only a small quantity of venous blood

<sup>10</sup> Reported in my first paper

escaped. Manipulating the canula in different directions showed that the tumor was not formed of a single pouch, but of a spongy tissue composed of large cells. This explains the slowness with which the fluid trickled out, and which, also, evidently passed through a narrow passage in the bone into the skull cavity. I could not discern the opening, nor did I recognize any rugosities or denudation of the bone.

The annexed case<sup>11</sup> of M. Hutin, which occurred at the Hôpital des Invalides, is reported by Dr. Gustave Dufour (*Compt. rend. et Mem. de la Soc. de Biol.*, t. 111, p. 155, 1851):

Achille Maximilien, Marquis de W., Comte d'L., born 1770, at Paris; entered infantry service in 1792. In 1799, in charging a redoubt in the Piedmont, he received a blow from the butt-end of a musket on right side of forehead about 3 cm. from median line. He remained unconscious for twenty-four hours. When he regained his senses he was told by the surgeon in attendance that there was a fracture of the skull, and the lesion was very grave. There was no wound of the integument, but a deep depression under the skin was quite perceptible to the touch. During the next year he was an inmate of different hospitals, and received divers forms of treatment, especially local pressure. The ultimate result of the wound was an infirmity which incapacitated him from following the profession of arms. When he leaned forward with head inclined towards the ground, he would feel a swelling form on the site of the wound, having the volume of a nut, of a violet color, and which would disappear spontaneously when he again assumed the upright position. In 1814 he gained admittance to the Hôpital des Invalides, and in 1847 M. Hutin, then becoming surgeon-in-chief, was peculiarly interested in his case, and added himself the following notes to the history of the case: "Cicatrix

<sup>11</sup> Reported in my previous paper.



not apparent; osseous depression very marked. The condition is, doubtless, the result of absorption of the diploë and the approximation of the two tables of the frontal bone. The pouch is small, formed at the expense of the skin, and is not apparent when the soldier is standing, sitting, or reclining on his back; but when he bends forward with the head lowered, the pouch makes its appearance and attains the volume of half an egg. It is livid in color; is formed, evidently, as are cysts in contused parts, and is dependent on a communication with the superior longitudinal or some other sinus.'

I learned that this old man, notwithstanding his age of 81 years, was in perfect mental and physical health. October 28, 1851. Seized with erysipelas of neck and thorax, complicated with chronic bronchitis, and died November 3.

*Necropsy—Head.*—No visible traces of erysipelatous action. Normal in size and contour. On forehead, 2 cm. below hair margin, and to right of median line, is a cutaneous space about 2 cm. in diameter, which is rendered distinct from surrounding skin by its rosy color, and this corresponds to a clearly outlined osseous depression beneath. Lowering the head now fails to produce the phenomenon which was so easily brought about during life. *Brain.*—Sound and without traces of old or recent apoplectic clots; white and gray substance distinct; vascular network of pia mater moderately injected, but without infiltration, and is easily separated and detached from the cerebral convolutions—even directly under the wound. The visceral layer of the arachnoid, however, on the right side, 3 cm. from the middle line, is glued down to its parietal layer and also adherent to the dura mater, and any traction exerted upon these adhesions causes a few drops of blood to ooze out into its (arachnoid) cavity. The dura mater is also easily separated from the entire surface of the bone except at this locality of 3 cm.

from the median line, where it is adherent to the osseous wall. Opposite to this attachment the bone is perforated by several small openings. Injection of water and insufflation of air into the superior longitudinal sinus demonstrates the existence of a pathological communication of the sinus with the blood pouch above. The calibre of the sinus is somewhat increased, and filled by a long, reddish, fibrinous clot. Skin over tumor thinned, and sends out from its inner fibro muscular surface attenuated fibrinous prolongations which attach themselves circularly to the periosteum on the circumference of the bone depression, and which depression is lined by a bit of cellular periosteum, and is 5 cm. in breadth by  $2\frac{1}{2}$  cm. in height. The circumference of the depression is formed by a notable thickness of compact bone tissue, but its centre is very thin and spongy. The floor of the depression is also divided, by a jutting out of compact structure, into two smaller depressions: the left one extends a little beyond the middle line of forehead, is rugose, and is sprinkled with little dark openings; the other on right side is more extensive, and is riddled with minute apertures—entirely deprived of its vascular element (diploë) and corresponds to the thinnest of the cutaneous cavity, at which point both skin and bone are semi translucent. The frontal suture plainly seen above and below the osseous lesion, but especially apparent on the altered surface. Finally, the tegumentary coverings are thinned, being deprived of all muscular and adipose tissue, and composed only of skin re-enforced by a delicate lining of fibrous tissue.

Hutin reports another case<sup>12</sup> (*Mém. de Médecine Mil.*, t. xiv, p. 232, 2e Série, 1854):

K., born in 1771; entered military service in 1790; received at the battle of Jena, Oct. 14, 1806, two sabre wounds on the head—the first on superior and middle of forehead, the second on top of the

<sup>12</sup> Reported in my previous paper.

head. Did not lose consciousness; fragments of bone extracted; recovery after about nine or ten months without any grave symptoms.

Forty years passed without his being troubled by any serious sickness; only suffered from severe headache. In March, 1846, while intoxicated, he fell into a bed of rocks, fracturing thigh and ribs. A pleuropneumonia was not tardy in developing; and in ten days thereafter he was also attacked with erysipelas, which was epidemic in the wards. Delirium; parotid abscess. March 24. Carries hand frequently towards summit of head to the right of the most prominent scar. Pressure here discloses circumscribed fluctuation and pain which did not exist previously. Diagnosing an abscess, a small incision was made into it, but only blood escaped. There was a blood-pouch containing a black, semi-coagulable liquid, poured out between the osseous vault and the pericranium, thus detaching the latter. Attempts to detect a fissure failed. The day following the dressings were soaked with blood; attempts to find fissure still futile; extended incision, which brought to view a slow, continuous oozing of venous blood from the depths of the bony wall and to inner side of the wound. This was without pulsation and uninfluenced by the respiration. A delicate blunt probe pressed upon this point readily passed on into the skull through a small opening which was covered over to about three-quarters of its extent by the soft tissues. Dry charpie and bandage arrested hæmorrhage.

*Autopsy.*—Scalp puffed up and much injected from erysipelatous inflammation. Cicatrix on frontal bone adherent to the remains of the frontal suture, with marked depression of the integument. At 2 cm. beyond the fronto-parietal suture and within  $1\frac{1}{2}$  cm. of the sagittal, commence the other adhesions belonging to anterior region of the *second* cicatrix, and which are equally resisting but of limited extent. Below these is the pouch which was incised during life.

This pouch (subpericranial) is about 4 cm. in extent from before backwards and 2 cm. from right to left. On removal of skull cap all was found normal except a trivial injection of the arachnoid, one or two points in the brain, and a small quantity of serum in the ventricles. Dura easily detached over almost entire vault, except at a point corresponding to the wound of the vertex, and on each side of the closed sagittal suture, where it adhered closely to the parietes, but without any visible scar. At a point corresponding to the external angle of the wound the dura mater intimately united with external tissues through a fissure in right parietal bone. The unclosed opening of the bone was about 2 mm. in width by 1 cm. long. Longitudinal sinus contained a small quantity of coagulated blood, which was partially dislodged by a stream of water—after which was visible a very pronounced projection in the sinus, passing in a line from behind forward and from right to left, and corresponding exactly to the external cicatrix. This projection was caused by a depressed thick bone-splinter depending from the internal table, and was the result, evidently, of the sabre blow—being partially detached and thus remaining fixed for many years. This spicula terminated in a spine which had perforated the sinus, and passing through into the lumen maintained patulous an opening in its walls about 4 mm. in size. Through this opening a small quantity of blood had escaped from the sinus, and which, poured out between the bone and dura, formed in this locality an oblong pouch of  $3 \times 2$  cm. in diameter; but on the outside of the skull it had diffused itself between the bone and the periosteum, forming the collection which had been mistaken and opened for an abscess. This external effusion had passed through an opening existing in left parietal, 1½ cm. in front of and to the right of the sharp end of the fragment, and resulting from the non occlusion of the bone divided by the sabre blow. Hence there was a direct communica-

tion between the superior longitudinal sinus and the wound in the integument, for in this fracture there were no adhesions between the meninges and the pericranium as existed through the anterior fracture. The perforation in the superior longitudinal sinus is a little to right of median line.

Stromeier refers to two examples. The first (*Ueber Sinus Pericranii*, *Deutsche Klinik*, Bd. 11, S. 160, April 13, 1850) is transcribed below:

A boy, 6 years of age. He sustained a fall on his head from a considerable height in his second year, resulting in a depression of the right parietal bone, which extended along the greater part of the sagittal suture. The point of greatest depression was  $2\frac{1}{2}$  lines. The entire depressed portion was covered by a blood-pouch of  $2\frac{1}{2}$  inches square, which when filled was raised about 3 lines. On complete emptying the bone was felt, and the outer table was evidently poorly formed. Turgescence of the tumor is favored by each circumstance which is likely to produce congestion of the head, namely: crying, coughing, dependent position of the head, compression of jugular veins, etc. When child was quiet no fluid was discernible in the pouch.

The second case, of more recent date (*Maximen der Kriegsheilkunst*, note, S. 362, 1861), is thus briefly mentioned:

A cavalryman in 1859 was dismissed from the army on account of a blood-cyst located on the frontal bone. When distended with blood it was the size of a pigeon-egg.

The cause of the growth is not stated in this instance, but on account of the profession of the patient, together with the connection in which it is referred to, I have been led to consider it as an example of the form due to direct injury, and thus class it as such.

There are, in addition, cases belonging to the traumatic division, mentioned by Schellmann (*Ueber*



Verletzungen der Hirnsinus," *Geissen, Inaug. Dissert.*), and quoted by Bergmann (*Deutsche Chirurgie*, Lief. 30, S. 365, 1880).

#### ETIOLOGY.

The two principal varieties of this lesion recognized by M. Dupont were these: First, when the tumor communicated with the sinus of the dura mater through normal skull-openings or canals, as varicose venæ emissaria passing through their respective foramina; and second, in which this communication with the intra-cranial venous circulation was effected by means of abnormal passages. This latter class might be due to fracture of the cranium and wound of the sinus; perhaps to a non-traumatic or spontaneous perforation of these structures; and, finally, to an ulceration of the osseous tissue and a vein in the situation where such a vein pierces the skull in its course to the sinus.

M. Dufour suggests another condition, that is, in which the extra cranial growth communicates with the sinus, either directly or indirectly through the medium of the diploic circulation. He considers this variety to be especially anticipated in persons of advanced years, in whom the diploic veins are greatly developed and frequently dilated into venous expansions or lacunæ.

The etiological classification adopted by Herman Demme is as follows: (1) Rupture of the external cranial veins, without scalp wound, resulting in cysts which may communicate in various ways with the sinus. Thus, a vein emptying into the sinus may become torn, and, forming an epicranial or aponeurotic blood-collection, after the manner of traumatic aneurism, communicate with the sinus by this means; especially in the case of the large parietal veins which penetrate the bone through their foramina located on either side of the posterior portion of the sagittal suture. It may occasionally happen, also, that,

under the pressure of the extravasated blood, bone resorption takes place, leading to opening of the veins of the diploë and through these to a communication with the deeper venous blood conduit of the dura. Again, the injury producing such an external blood collection may itself excite absorption and perforation in the position of a Pacchionian fossa or depression, and by this method intercommunication between the sac and the sinus system be established. (2) Varices of the external cranial (emissary) veins forming cysts which unite directly, through their relative openings, with the corresponding sinus. (3) Extra-cranial venous cysts resulting from enlargement and dilatation of the sinus itself. These are produced either by gradual absorption and breaking through of the cranial parietes, or they are pushed forward and protrude through a normal or preëxisting opening, like for example, a fontanelle.

In closing a brief but interesting article on this character of formations, MM. Follin and Duplay declare that with the information before them they can admit only two varieties, namely: First, tumors produced by traumatic ruptures of the sinus; second, tumors resulting from atrophy and perforation of the bone in the region of the sinus or of the Pacchionian cavities. They add, however, that it may be possible, although an exception of extreme rarity, for tumors of this nature to be produced by a varicose dilatation of an emissary vein of the sinus. But, they continue, "we may be permitted to express some doubts as to the existence of this variety."

Bruns describes two forms of varices of the extra-cranial veins communicating with the dural circulation, under the description of (1) *varix verus circumscriptus*, and (2) *varix verus cirsoideus*.

Stromeyer believes that these lesions are usually produced by a rupture of an emissary vein, resulting in blood extravasation and formation of a limiting sac beneath the pericranium.

The theory of osseous atrophy—rarefying osteitis—first formulated and advocated, I believe, by Simon Duplay, is supported by Legouest and Servier, Azam, Foilin and Duplay, and many others. The initial step in this process is claimed to be found in, (1) a trivial or even unnoticed traumatism, in the form of a contusion; (2) in the erosive action of the Pacchionian granulations alone; or (3) in both the first and second combined—the one being dependent upon the other. The final rupture of the rarefied osseous point may be accomplished either spontaneously, or caused by some slight shock or blow.

These general etiological outlines, as applied to the several groups separately, call for a more complete elaboration.

A. *Congenital Group*.—The points and theories to be examined relative to the etiology of the congenital cases, mentioned in the order of their seeming prominence, are as follows: (a) Aneurismal or varicose dilatation of one or more emissaria Santorini; (b) Localized morbid processes in the structure of the sinus wall—a phlebectasia or true varix of the sinus; (c) Pathological enlargement and dilatation of the venæ diploicæ; (d) Certain hereditary vices, such as syphilis and struma; (e) Developmental arrests, as want of closure of a fontanelle, abnormal fontanelles, etc.

a. Notwithstanding the questionable opinion expressed by some authors as to the rôle played by varicose venæ emissaria in the production of this form of sanguineous tumor, the preponderance of general evidence, clinical and anatomical, is most decidedly in favor of such a morbid association, and therefore I must claim conspicuous recognition for it in this position. In clinical proof of this union the cases of Moreau, Mersemann, Aclard, Michaud, Stromeyer and Verneuil bear ample testimony; and hence not only dispel any serious doubt as to the etiological office of such varicosities, but even ac-

cord to this factor a high rank in the causal list of the present collection of congenital cases. In four of the cases intelligent and carefully conducted post-mortem sections, with surgical examination in the fifth, demonstrated the real character of the lesion.

*b.* Diseased processes in the sinus wall, producing hernial protrusion, or true ectasia, of the sinus itself, is upheld by the recorded examples of Demme and Foucteau, and probably that of Flint, in two of which a necropsy disclosed the extent and nature of the tissues involved. In Demme's patient the microscope was employed in verifying the post-mortem appearances, and in the other (Foucteau's) one or more of the coats of the sinus was clearly recognized by the unaided vision as entering into the composition of the sac.

Francke (*Lehrbuch der Chirurgie*, Bd. 11, S. 49), expresses the belief that such blood pouches formed at the expense of the sinus wall, can occur only in monstrosities and non-viable children; but the above instances, especially that of Demme, are fair evidence of the incorrectness of his views and statement.

Furthermore, Velpeau (*Gaz. des Hôpitaux*, t. viii, 2e Série, p. 87, 1846) mentions having seen in two instances (presumably congenital), extra cranial blood-tumors caused by a phlebectasia or hernia of the dural sinus; once near the anterior fontanelle, and a second time in the region of the occipital bosse.

*c.* Disease and enlargement of the diploic vessels is represented by the patient of Francke (and several others), in whom there was a blood tumor identical, apparently, with a frontal diploic vein, and associated with congenital resorption or absence of a portion of the outer table.

*d.* Hereditary syphilis or the rickety diathesis occasionally finds expression in the production of craniotabes, where areas or spots of softened and thinned osseous structure take place in the cranial walls, only requiring some slight internal or external pressure to

convert them into veritable skull perforations. Although this condition is but seldom observed congenitally, occurring principally in syphilitic infants during the first year subsequent to birth, yet it is worthy of note that this sometimes does happen; that the inner cranial aspect is usually the primary seat of attack; and that they are generally observed occupying the posterior parts of the parietal bones—about the position where one form of this venous tumor is most frequent; and, too, in which neighborhood the Pacchionian bodies most abound.

Parallel with this observation the so called gelatiniform degeneration of the outer table of the skull (Parrot) must be referred to, as offering points for consideration in this study.

*c.* The influence of certain developmental arrests suggests a field for inquiry.

These may be shown in want of closure of the normal fontanelles, thus facilitating hernial protrusion of the dural sinuses; and in abnormal fontanelles, as absence of ossification in the ossa Wormiana. Against the latter, however, in those instances where the growth is situated centrally and anteriorly on the head, may be urged their extreme infrequency in the median part of the cranial vault.

Another condition having a possible, if not probable, relationship to the etiology of the congenital class, is to be found in traumatism from head pressure during parturition.

A wound or rupture of the sinus may occur at birth, as stated by Bergmann (*Deutsche Chirurgie*, Lief., 30, 1880), when the overlapping of the cranial plates, in the line of their sutures, exceeds a certain limit—an occurrence that, in spite of the great changes in shape and size to which the foetal skull is subjected in a narrow pelvis, must be considered rare. He mentions also that Litzmann (*Ueber den Einfluss des engen Beckens auf die Geburt im Allgemeinen*, in *Volkmann's Sammlung Klin. Vorträge*,



Nr. 23, S. 191, 1871), saw the *sinus longitudinalis* twice torn during labor in cases of generally contracted and flattened pelves, where the pressure from the promontory upon the already compressed head was so great as to force the sharp serrated edge of the sagittal suture through its tense coverings. Both children died shortly after birth.

Similar cases are reported by Michaelis ("Das enge Becken, noch eignen Beobachtungen herausgegeben von Litzmann, Kiel, 1865), Weber (*Beiträge z. pathol. Anat. der Neugeborenen*, Lief. 1, Kiel, 1851), Olshausen (*Deutsche Klinik*, S. 365, 1864) and C. Hennig (Die Kopfbtutgeschwulst, in Gerhard's "Handbuch der Kinderkrankheiten," Bd. 11, S. 54). Again, the same injury of the *transverse sinuses* was met with by Weber (*loc. cit.*) and Breisky (*Prager Vierteljahrsschrift*, Bd. 63, S. 178).

Under such circumstances where there is a limited wound of the sinus, particularly if the external tissues or scalp escape implication, it is easy to appreciate how this character of tumor can be thus originated.

Finally, it should be noted that in all the clinical cases belonging to the congenital group which were positively determined by post-mortem dissection (varicose venæ emissaria, ectasia of the sinus, and dilatation of the diploic veins), the lesion had its origin, apparently, in a morbid action of the vein-wall itself, namely: a venous hypertrophy and phlebectasis.

B. *Spontaneous Group*.—The several explanations proposed as to the origin of the spontaneous group may be summed up in the subjoined arrangement: (a) Absorptive or erosive action of the Pacchionian glands; (b) An obscure form of osseous resorption, or rarefying osteitis; (c) Varicosities of the venæ emissaria; (d) Localized morbid processes in the sinus wall, producing bone absorption, and consequent hernial protrusion of the sinus; and (e) Certain constitutional or systemic vices.

*a, b and c.* As previously referred to, two forms

of osseous implication were recognized, that is, bone resorption dependent upon two separate and distinct causes, namely: an osseous atrophy resulting from the absorptive or erosive action of the glandulæ Pacchioni, and a rarefying osteitis due to some remote contusion. Careful investigation, however, has determined me to include the two forms under the single title of *rarefying osteitis*, since it is very probable that the osteitic changes ascribed to the action of the Pacchionian granulations are very similar to, if not identical with, those resulting from bone contusion, especially as the history of a blow or fall is often associated with the special individual action claimed for these glandular bodies.

Furthermore, the bone resorption resulting from localized diseased processes in the structure of the sinus itself, followed by a true sinus varix or ectasia, is, doubtless, closely allied to the above forms of osteitis, and, hence, this should be comprehended, also, under the single form mentioned. Therefore in the following remarks I shall speak of one variety of osteitis only as produced by the three above named factors. The hypothesis of a rarefying osteitis with spontaneous perforation in the so-called spontaneous cases was suggested by M. Simon Duplay (vide Duplay, also Follin et Duplay), who formulated his theory upon the researches of Trolard upon the venous system of the skull and brain. This author (*Recherches sur l'Anatomie du Système Veineux du Crâne et de l'Encéphale, Archives Gén. de Méd.*, t. 1, Mars, 1870) described as situated on the lateral parts of the superior longitudinal sinus, certain areolar venous spaces or *lacs sanguins*<sup>13</sup> corresponding to the fovea glandulares, limited on one side by the osseous surface, and which, bathed by the venous blood, communicate

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<sup>13</sup> These structures were described, prior to the publication of Trolard, by Cruveilhier, Luschka, Henle and Meyer. They are designated as *lacune lateralis sinus* by Key and Retzius, and have received also from Browning the euphonious term of *Parasinoidal spaces*.

freely with the superior longitudinal sinus and the venous canals of the diploë.

A brief résumé of the theory advocated by Duplay is as follows: The osseous lesion is the first degree or stage of the morbid formation. The bone is subjected to a blow or fall—a contusion—which produces a partial localized atrophy of the skull. This atrophy of the cranial bone is not extremely rare, occurring at all ages, and often taking place in limited areas or spots, particularly on the lateral parts of the superior longitudinal sinus over the fossæ lodging the Pacchionian glands, and in which, also, are these spaces or *lacs sanguins* communicating freely with the sinus, and upon which anatomical disposition the theory is based. Thus, taking one of these points, atrophy is developed consequent upon a trivial blow and progresses steadily, reducing the bone to an exceedingly thin lamina, until spontaneous perforation is produced, or perhaps more frequently, a slight secondary contusion or shock may supply the rupturing force, and an opening into one of these venous spaces or lacune is effected. By this means intercommunication with the sinus is established, venous blood escapes and is effused beneath the periosteum, the tissues are floated up, and this type of blood-tumor of the cranial vault is the result. “It is thus, probably, that one would be able to explain the relation ascertained to exist in nearly all cases between the development of the tumor and the previous action of a blow or fall.”

This theory of a rarefying osteitis in spontaneous cases is accepted in full by Legouest and Servier; and these authors even apply it to a more extended field than that claimed by Duplay, since they assume that the same theory is applicable to the pathogeny of analogous tumors developed in other portions of the cranium—first when occurring over the mastoid cells or the frontal sinus, a pneumocèle resulting; or, second, even the diploic structure may become

involved. In explanation of the latter involvement they refer to the existence in the diploe of ramifying cavities, lined with the internal venous coat (intima), communicating as freely with the dural sinus as with the extra-cranial circulation. These diploic canals constitute, especially in old persons, a continuous system which unites abruptly with four or five principal confluent passing to the cavernous sinus, the ophthalmic vein, the middle meningeal vein either directly or through the intermediary of the posterior condyloid vein. It results, therefore, that the wear of the cranial table opposite to these confluent may give rise to the development of a sanguineous tumor in communication with the intra-cranial venous circulation without the longitudinal sinus being perforated.

M. Azam believes that traumatism is always the point of departure of a rarefying osteitis; and Du-four also considers the abnormal communication to be caused by an obscure form of osteitis, followed by interstitial resorption of bone, the probable consequence of a trivial contusion.

Many authors rather question the possible rôle ascribed to the Pacchionian granulations of producing atrophy and skull perforation, among whom may be mentioned Meyer, of Hamburg (*Virchow's Archives*, Bd. xix, p. 171), whose rich experience in this field of inquiry entitles his opinion to consideration. Notwithstanding very elaborate investigation and examination of these bodies he has failed to encounter a single instance in which the fovea glandulares of the calvarium extended to actual perforation.

But, on the other hand, some writers advocate this theory, giving it decided preference over any other, as shown by the opinion of Dr. Gross (*System of Surgery*), who asserts that "the most common cause of the abnormal communication is spontaneous, progressive absorption of the osseous tissue corresponding with the Pacchionian depressions, when, under

the influence of slight traumatism, the blood escapes beneath the pericranium."

Again, as a direct example of this character of perforation accompanied by a rupturing force or shock, the following case mentioned by Demme will be found of special interest and importance:

A robust man falling from a high building scaffold received numerous severe injuries which proved fatal in ten hours. At the autopsy there was discovered a large blood effusion extending over the posterior part the sagittal suture, and which was found to be, for the most part, beneath the periosteum. After carefully washing the clot there was shown to exist, on the left side of the sagittal suture, a sharp-edged opening the size of a cherry stone, through which protruded a Pacchionian granulation covered over by coagulated blood. On removal of the skull-cap a second coagulum was observed interwoven with the meshwork of the large Sickel sinus, and which (the sinus) communicated directly with the extra-cranial hæmatoma through this resorptive opening of the Pacchionian gland. My examination left no doubt in the matter that the intra-cranial hæmorrhage arose from a rupture of one of the numerous venous vessels tearing through the fibrous walls of the sinus.

In further support of these views I may refer to those obscure alterations and perforations occasionally met with in the petrous portion of the temporal bone, sometimes opening the tympanic cavity, which, according to Luschka, like the fovea glandulares of the calvarium, are not improbably the result of pressure exerted by these villous-like vegetations.

Typical examples of this pathological process (rarefying osteitis) are furnished by the cases of Bruns, Hecker, Dubois, Giraldès, and Duplay, for, although not positively demonstrated to exist by post mortem sections, they have the history of a contusion followed after a delayed period by the appearance of



the tumor, together with the subjective symptoms to be anticipated under such circumstances.

The cases of Bruns, Dubois, and Duplay were regarded as being connected with the sinus either immediately or through the medium of the diploic canals. But all the symptoms seem to indicate to my mind, that Bruns's case was associated with the veins of the diploë, whilst those of Dubois, Giraldès and Duplay were, doubtless, in direct communication with the sinus.

On the other hand, the patient described by Hecker was suffering clearly from a blood-pouch first communicating with the diploë and then leading to the sinus—the result of extensive cranial loss. Hecker explains the origin and formation of this case (*varia spuria circumscriptus vena diploica frontalis*) about in this wise: In consequence of a fall on the head in infancy a separation of the outer cranial table was produced with tearing of the diploic vessels, which is easily explained from the thinness of the external table and the great vascularity of the infantile skull. The blood escaped now from the diploic veins into the adjacent cellular tissue under the skin, and as the repair of the vein-rupture (perhaps on account of anatomical conditions) was not effected, the hæmorrhagic effusion continued until the cellular tissue became infiltrated and, as it were, consolidated. Now, however, this consolidation forming a barrier against further bleeding, a pouch with well-defined walls was finally formed, which, gradually but more or less completely filled with blood, emptied its contents, by means of the supra-orbital foramen, into the external cranial veins, especially the vena supraorbitalis. Osseous absorption rapidly supervened, and the tumor reached its present limits.

Hernia or ectasia of the sinus is shown in only one instance, namely, the specimen of the Jacobi. There is considerable doubt expressed, however, by several authors, whether it was of congenital or spontaneous formation, but both Bruns and Demme are decided

in their opinion as to its being spontaneous. Here, also, as before suggested, it is more than probable that osseous atrophy was the active element in causing the skull opening.

c. Varicosities of the venæ emissaria is exemplified in the cases of Melchiori and Andrews, in both of which necropsies disclosed the morbid changes.

Dr. Andrews gives this solution of his case: A small vein penetrated the skull (occipital emissary vein) communicating with the torcular Herophili and the scalp, and the protracted determination of blood to the brain produced enlargement and distension of the torcular,—this emissary vein also receiving a proportional increase in its calibre. Like the continued drop wearing a stone, so the oft-repeated *vis a tergo* expansion wore the bone, producing the pulsating tumor (in thus dilating the vein) and the large foramen in the skull.

In regard to spontaneously arising single or *circumscribed* dilatations of the external cranial veins, Bruns (Op. cit., p. 191) expresses the opinion that they are extraordinarily infrequent. This assertion is based upon his personal experience of two cases, with one other which he had found recorded.

e. Constitutional and systemic vices—more especially syphilis and struma—deserve notice as occupying a possible causal position. Such is manifested in those osseous changes already referred to in the congenital group; but in this category there should be included, also, any systemic condition predisposing to bone alteration or degeneration. Furthermore, it is quite possible that, in cases of rarefying osteitis, there is often some constitutional condition—a predisposition—which renders the osseous tissue peculiarly susceptible to the taking on or lighting up of this atrophic process upon the reception of a confusing force. Suggestive of this is the case of M.M. Nèlaton and Richard, in which the growth was not discovered until after a severe illness of the patient.

*C. Traumatic Group.*—Direct traumatism is the essential element to be recognized in the etiology of this class, and the necessary conclusion deduced therefrom is that, in all traumatic cases fracture is, practically, invariably present, wounding the sinus wall by, (i) either depressed fragments or detached spiculæ, as in any comminuted fracture; (ii) by punctured fractures, the instrument used in such fractures also penetrating the underlying sinus; (iii) by the separated sharp edges of the fractured bone, especially if the line of fracture passes across the suture to which the sinus is attached; (iv) the sinus may be torn through by a disjunction or separation of the sutures over the sinus, particularly the sagittal suture.

There is, however, another method by which this lesion may be possibly caused where fracture is not a necessary accompaniment, namely, rupture or tearing of the sinus without fracture or suture-separation, produced by certain decided changes in the form of the cranium resulting from heavy blows inflicted by some broad, flat instrument (Bergmann). I have no record of an example so produced, but the injury demands notice as standing in the category of possible factors.

From this last character of injury experience shows that the transverse sinuses tear more frequently than the longitudinal, which is explicable not only on the ground of their anatomical location and connections, rendering them much more fixed and unyielding than the latter, but also in the fact that the cause resides, perhaps, in the direction of the rupturing forces, which commonly operate from above and behind. Thereby the cranium is compressed from above downwards, but expanded laterally,—an expansion which must cause great stretching of the transverse sinuses, and, as seen, a giving way, occasionally, of their walls. On the other hand, rupture of the torcular Herophili is, of all the sinuses situated directly be-

neath the cranial walls, the most rarely met with.

It should be noted, also, that in the analysis of the seven traumatic cases, six are characterized by the absence of external or integumentary wound, and in only one is the fracture open or compound. Hence this preponderance of subcutaneous or simple over compound fractures in association with this injury, must be mentioned as a point of special interest. It is necessary to remark, however, that investigation has shown that laceration of the sinus from cranial fracture with depressed bone-splinters, without simultaneous scalp wound, is comparatively rare. Nevertheless, in one of Stromeyer's cases it is important to refer to the fact that it was a child who had his right parietal bone depressed, from a blow the result of a fall, without cutaneous wound, furnishing another instance of injury of the sinus from a simple fracture.

#### PATHOLOGICAL ANATOMY.

Fortunately the collected cases represent a goodly number of authentic post-mortem sections, together with valuable surgical examinations; and consequently, these furnish pathological data of a character sufficiently definite to enable, it is believed, the formulation of rational and decisive conclusions—conclusions which are also added to and strengthened by marked symptoms and conditions, as manifested by numerous clearly analyzed cases without post-mortem demonstration.

A rapid rehearsal of the anatomical facts collectively, before entering into the examination and consideration of individual pathological points, seems advisable.

Moreau's Case.—There was a venous varix formed of congeries of veins, terminating in enlarged and dilated vessels which passed, by means of three perforations in the frontal bone, into the longitudinal sinus. For a large extent around these osseous

openings the dura mater was inflamed and covered with pus.—a phlebitis and meningitis the result of the previous operative treatment. This is an example of **venous varicose tumor**.

**Michaud's Case**.—Two erectile growths, one over brow and eye lid, the other located on the head. They were composed of a cavernous tissue, under the seat of which the bone was perforated by a multitude of little apertures giving passage to the veins coming from these structures in their course to the superior longitudinal sinus.

**Foucteau's Case**.—Occupying the site of the posterior fontanelle was a blood tumor which communicated directly with the superior longitudinal sinus through a single opening in the fontanelle the size of the little finger, by means of a tubular pedicle of which the cyst appeared to be an expansion. The tumor was composed of two principal cysts with a small accessory pouch, which were lined by a vascular serous membrane. This serous membrane was of the same character as, and continuous with, that of the cerebral sinus through the above mentioned pedicle. Thus it would appear that this was a blood-cyst formed by a hernia of the sinus through the unclosed posterior fontanelle, in which only the serous coat of the sinus was recognizable by the eye alone.

**Demme's Case**.—Located on the top of the head (in the middle of the sagittal suture) was a tumor composed of a pouch the interior walls of which were covered by fibrinous laminations, of different color and consistence, according to their respective ages as in a true aneurismal sac. In the coagulum in contact with the bottom of this pouch was a funnel-shaped depression which proved to be the entrance to an opening leading to the cranium. The superior longitudinal sinus was distended and filled with a coagulum, and was considerably dilated at a point corresponding to the external tumor with which free communication was demonstrable. The external



wall of the cyst consisted of the normal scalp, but the other layers were composed, very evidently, of the sinus walls protruding through the osseous opening. Traction upon the tumor showed that the opening in its base consisted of a tubular pedicle connecting its cavity with the sinus. The pericranium did not enter into the formation of the cyst coverings, but was intimately attached to the circumference of the skull opening and the pedicle, showing that it had either ruptured or been absorbed. The cranial tissue was thinned throughout the space occupied by the tumor, rather transparent, and in a state of rarefaction. The walls of the sinus were thickened, especially the fibrous elements, but otherwise little altered. The microscope was employed in the examination. This presents a case of true ectasia of the superior longitudinal sinus through the anterior fontanelle, probably the anterior angle.

Acland's Case.—The growth was a venous capsule communicating through a foramen in the protuberantia occipitalis, by means of a fibrous tube, with the Torcular Herophili, thus putting the cyst in communication with the intra cranial venous circulation. Brain greatly enlarged, and anterior horn of one lateral ventricle distended with serum (hydrocephalus). Here is shown a circumscribed venous varix of an emissary vein (emissarium occipitale) passing to the Torcular.

Bruns' Case.—Located over posterior fontanelle, with a thick pediculated base. Surgical examination after strangulation and removal of the growth demonstrated the structure of the formation to be a mass of areolar tissue containing a bunch of greatly thickened veins, in which were several spherical enlargements or dilatations. Beneath the cicatrizing ulcer left after removal of the tumor the underlying fontanelle was plainly felt. This is another instance of varicose emissary vein or veins passing to the sinus through the posterior fontanelle or below it.

**Busch's Case.**—A large fluctuating tumor, occupying the superior occipital region, including the small fontanelle. Contained a quantity of dark, viscous blood. The fluid situated between bones of skull and pericranium, and was in communication with the sinus. Several vessels extending from the tumor to superior longitudinal sinus were divided by the post-mortem incision. Character of tumor not definite, but possibly a **venous varix**.

**Flint's Case.**—A tumor in occiput. Contained venous blood, and communicated with superior longitudinal sinus. Probably an example of ectasia of the sinus.

**Jacobi's Case (Morbid Specimen).**—A large cyst filled with coagulum located on occiput. Perforating the os occipitis was a large and long opening or canal through which the sinus protruded as a hernia under the scalp. The question arises, Was this not a varicose occipital emissary vein traversing its normal but enlarged foramen? However, it is received by several authors as a true hernia of the sinus, and, with the unsatisfactory data at hand, I must now also accept it as such.

**Melchioni's Case.**—Located on left parietal bone. Tumor composed of a net-work of empty veins ranging in size from a thread to a pigeon quill, freely intercommunicating, and finally terminating in a common trunk about the thickness of a goose quill. This trunk passed through the galea aponeurotica capitis, and piercing the skull at the lower and posterior edge of the parietal bone, emptied into the transverse sinus where this canal lies on inner surface of temporal bone. There was meningitis, and all the sinuses were filled with partially suppurating clots, although without disease of their walls. This was a case of varix of the external cranial veins communicating with the sinus.

**Andrews' Case.**—On removal of the scalp a number of enlarged and distended veins were seen about

middle of the occipital bone. Just below the external protuberance was found a depression in the bone of one-third inch in diameter and one-fourth inch in depth, and covering which was a membrane that appeared to be formed of thickened walls of a distended vein, and upon puncturing this venous blood escaped. The depression was then found to be a complete perforation, about the size of a crow-quill, which led into the sinus. There were tubercular deposits in brain, and serous effusion into both membrane and ventricular cavities. This was a case of circumscribed varix of the emissarium occipitale.

Pott's Case.—A blood collection on top of head. Operation disclosed depressed fracture with a sharp fragment piercing superior longitudinal sinus.

Hutin's Case.—Blood pouch on right frontal region, communicating, through an old traumatic bone perforation, with the superior longitudinal sinus. Osseous atrophy also evidenced.

Hutin's Case.—Fluctuating blood pouch on right side of summit of head, between osseous vault and pericranium. Perforation of under and right side of longitudinal sinus by a thick bone splinter, thus placing the blood sac in communication with the sinus. Another blood collection internally between dura and skull, which also communicated with both sinus and external tumor.

The individual points which call for consideration are these: I. The general character of the tumor; II. The anatomical relations of the tumor, including the nature of the tissues composing and limiting it; III. The contents; IV. The method of communication with the intra-cranial circulation.

I. *The General Character of the Tumor.*—This tumor may be defined as, an indolent swelling external to the skull, in the form either of (i) a cyst—single or compound—or of (ii) a varicose or an erectile growth, containing venous blood, and communicating, directly or indirectly, by one or many skull per-

forations—normal or pathological—with the intracranial venous circulation.

The indolent nature of the growth is too fully and prominently shown in the detailed history of the cases to necessitate further notice,—the only inconveniences complained of in the large majority of instances being subjective, or due to the annoyances of its particular location.

(i). The pouch—or cyst—variety is, as its name implies, composed of a pouch or sac variously formed, and the character of this formation being dependent upon the cause in operation. It can be asserted, therefore, from an etiological standpoint, and largely sustained by necropsic evidences that this form is encountered in circumscribed dilatation of an emissary vein (fusiform); in ectasia or hernia of the sinus and in dilatation of a diploic vessel (sacciform); in cranial perforation the result of a rarefying osteitis, and in the greater number of cases produced by direct injury, including both skull fracture and rupture of an emissary vessel (false). These features mark this variety as being closely allied to aneurismal formations in general, and whereas these characters are met with in the majority of cases, at the same time they cannot be considered so characteristic of this division, as was formerly my opinion.

Several post-mortem dissections, with every physical indication in many other cases without the conclusive proof of autopsic examinations, furnish sufficient demonstration for these conclusions.

(ii). In the other form—the varicose variety—the tumor is composed of tortuous and varicose veins (chiefly the emissaria Santorini) with numerous dilatations, or, occasionally, of a structure resembling true erectile or cavernous tissue (Michaud's case). These varicose formations may be in both fine and gross bundles held together by a meshwork of areolar tissue, and consisting of simple tortuous veins alone or combined with dilatations. Many cases in

all three of the classes, the congenital, spontaneous and traumatic groups, illustrate this variety.

II. *The Anatomical Relations of the Tumor.*—Taking the coverings of the cranium in their order from without inwards, I find the anatomical location of these formations may be, (a) between the integument and the cranial aponeurosis; (b) between the fibro-muscular layer (aponeurosis) and the pericranium; (c) between the pericranium and the bone; and (d) occasionally extending internally between the skull and the dura mater.

These conclusions, which were reached in my previous paper, were then based upon the recognition chiefly of one principal variety of this formation, namely, the *diffused*, where the effused blood escapes beneath the scalp tissues; and even with a more extended knowledge of the etiology and pathology, including the wider and more comprehensive classification now given to the lesion, these relational divisions are, in the main, still appropriate.

(a) The situation of the growth between the skin and the epicranial aponeurosis, although not determined by the positive evidence of actual dissection, can be considered as, at least, probable, especially in certain injuries where all the soft tissues, together with the bone, are torn through or divided except the skin, leaving that covering intact; or, again, in those cases where absorptive action is particularly prominent; and, also, in long-standing cases with a disposition to rapid tissue change, hastened, perhaps, by increased blood pressure. But clinical observations alone are not adequate to fix this exact seat, for, it must be noted that the sensation and appearance of the swelling are very deceiving in the impressions they convey of the composition of its walls. Thus in many instances both the skin and aponeurosis may be so extremely thinned or attenuated as to impart to the touch the sensation of only integumentary thickness, and accompanied, at the same time, by a



violet hue as if the contained blood was immediately beneath the cutaneous covering. Furthermore, the probability of this position is re-enforced somewhat, if the first proposition of Demme be looked upon as tenable, that is, rupture of an external cranial vein from injury, producing an *epicranial* or *aponeurotic* blood-collection which results in a cyst, and finally in communication, by various ways, with the sinus through absorptive changes in the underlying tissues. Under such circumstances it can be readily appreciated how a venous blood-tumor of this description may be located between the integument and the **fibro-muscular layer of the scalp.**

Again, in thickening and dilatation of the cranial veins, the diseased action may originate in and be confined to that portion of the vein lying between the skin and the aponeurosis, and thus the tumor be so situated, as is shown in the case of Melchiori, and some others.

(b.) I am inclined to consider the location of this formation between the aponeurosis and the pericranium as its most frequent seat,—an opinion, it should be remarked, that applies particularly to those cases arising from within outward or from the interior of the cranium. This position was demonstrated by post-mortem examination in a number of instances; and theoretically it may be looked for in the majority of these tumors due to spontaneous perforation of the skull, cranial fracture with sinus wound, ectasia of the sinus, and disease of the diploë veins, in which, especially the two first named, the periosteum is, in all probability, lacerated, and the blood extravasated in the cellular tissue beneath the more movable aponeurosis. Opposed to this view, however, is the opinion of Stromeyer, who expresses the conviction (*Maximen der Kriegsheilkunst*, S. 362, 1861) that the cyst is always beneath the pericranium. He declares that the case of Dufour's in which the necropsy exhibited the bone covered by a thin periosteum is not opposed

to his views, since all bone reproduces its periosteum when deprived thereof. But as evidence that the assertion cannot be applied unconditionally to all cases, it is only necessary to refer to the simple example of Demme's case, where, with the aid of the microscope, in a hernia of the sinus through the anterior fontanelle, it was seen that the pericranium did not enter into the cyst coverings, but was perforated and intimately attached to the circumference of the skull-opening and to the pedicle of the tumor as it passed into the cranium.

(c) Notwithstanding the assertion of Stromeyer and others, that the cyst (pouch-variety) is always seated between the pericranium and the bone, I am forced to regard this location as rare; or, at any rate, it is not the rule. This opinion is held not only from the fact that I have succeeded in finding but two examples of such a location, but also from the anatomy of the periosteum and the associated tissue involved. Such, however, may sometimes occur, of which the testimony of Stromeyer with the illustrative cases of Busch and Hutin present sufficient proof.

(d) The location between the pericranium and the bone and extending internally between the skull and the dura (vide Hutin's case) is accidental, and consequently exceptional, and does not demand further consideration. It can occur, obviously, only in serious injury to the cranium with both internal and external hematoma, and is not particularly connected with this class or character of tumor.

From the foregoing remarks it is very apparent that the coverings or walls of these venous formations of the head communicating with the intra-cranial circulation, are absolutely dependent upon the etiology and special form of the lesion. For example, the tunics of such a growth arising in diseased action of the coats of the sinus with protrusion through the bone, cannot be compared with simple blood effusion from skull and sinus perforation, under the scalp,

and, therefore, its location and the composition of its walls must necessarily vary with the form and mode of origin of the tumor.

Again, each and all of the tumor-coverings may be normal in texture and relationship to each other, or considerably modified or changed by diseased or natural processes, and, indeed, even differing according to the age of the individual affected.

III. *The Contents.*—Besides normal fluid venous blood, which is of course always present, this tumor may contain occasionally solid elements; but, as would be naturally anticipated, such substances seem to be confined to the cyst or pouch-variety, and, perhaps, in certain examples of the varicose form where gross dilatations with thickened walls exist.

These solid elements may be of the character of condensations from the cellular tissue, or blood concretions (phleboliths) as indicated in one of Middelдорff's patients, and also the case of Jules Dubois, where, after complete emptying of the sac, a "core-like" substance about the size of a lentil was felt; or, again, the cyst may be lined by laminated fibrinous deposits identical in formation and composition with aneurismal coagula, and of which the case of Demme furnishes an excellent illustration.

In the instance mentioned by Foucteau three cysts were present,—the third or accessory cyst being filled with serum. But this was, undoubtedly, of accidental formation due to recognizable causes (witness the occasional formation of similar cysts in encephalocele and meningocele), and hence, although noteworthy, is without any associative significance.

IV. *The Method of Communication with the intra-Cranial Circulation.*—The manner of communication (direct or indirect), and the nature of the passage connecting the tumor with the dural circulation (normal or abnormal skull-openings), are as different and various as the causes which originate the lesion, and,

indeed, it may be considered as bearing a very intimate, if not constant, relation to the etiology.

When the union takes place through normal or preëxisting cranial apertures, as the emisary foramina and the fontanelles, the perforation partakes of the usual qualities and appearance of the natural and healthy tissues forming the opening, although in some cases they may be changed, in both size and contour, and, perhaps, with alteration in the quality of the bone. This method of connection is exemplified in hernia of the sinus through the fontanelles and in varicose dilatations and enlargements of the emissaria Santorini.

When the communication is effected by means of abnormal perforations then the distinctive qualities and features of the communicating opening and passage must be largely influenced by the causative agent in operation, that is, whether it be produced spontaneously or by appreciable traumatic forces, together with the probable changes caused by the duration of the tumor.

In the instance of the former where the glandular Pacchioni appear to be the exciting or active causes of the resorptive changes in the bone—a rarefying osteitis—an aperture may be looked for of moderate capacity, and presenting an irregular and uneven outline; whereas a rarefying osteitis the result of, possibly, extensive contusion, especially if located on the frontal region with involvement of the diploë, may be attended by a very extensive loss of substance, forming an opening with jagged edges, according to the extent of the osseous tissue subjected to the exciting cause.

In the latter or traumatic cases, the orifice is directly dependent upon the character and severity of the injuring force, that is, it may vary from a delicate crack or minute puncture with displaced spiculæ to an extensive loss of the cranial wall; or, again, it

may assume the features of a wide fissure, as in suture separation with displaced bone.

The number of the apertures, also, is dependent upon the special features of the tumor, varying from one to a large number, but where they are numerous, or, at least, several in number, the tumor is probably composed of an aggregation or bundle of fine varicose vessels, which penetrate the skull by exceedingly small foramina.

Again, the communication may be either direct or indirect—a condition which also stands in a certain ratio to the cause. Examples of the direct connection, where the tumor cavity opens immediately into the sinus, are shown in spontaneous perforation through the fovea glandulares, ectasia of the sinus, and in some traumatisms.

The indirect, where the bone perforation is sinuous, or, in other words, there is a medium, in addition to the perforated bone, through which the tumor is connected with the sinus, is illustrated in all dilations and varicosities and ruptures of the external veins, or where the communication is through the intermediary of the diploic canals.

Therefore, if any generalizations can be based on the revelations already made by clinical and post-mortem investigations, it can be safely affirmed that, First, in the *simple* or *diffused* class the cranial perforation is usually of abnormal production or formation, single, of moderate size, irregular contour, and direct; and, Secondly, in the *venous* or *vascular* class the communication takes place more frequently through a normal skull opening, is variable in size and number, of a definite shape, and indirect in its course—but exceptions to this may exist, as seen in certain cases of rarefying osteitis with diploic involvement.

#### SYMPTOMS.

In the majority of cases the presence of the growth produces so little discomfort or uneasiness, and in



some instances not the slightest inconvenience, other than that of location, is experienced by the patient, that it is scarcely possible to name any general symptoms which may be regarded as characteristic of the lesion.

Among such indefinite or variable symptoms encountered, however, *vertigo* or *dizziness* is the most prominent and most constantly present. In many of the cases this symptom was complained of, especially when the tumor was at its maximum volume, but not always appearing spontaneously, and more often the result of posture with the head dependent or flexed; or produced by compression of the growth, particularly such as to cause the rapid forcing out of its contained blood, although, on the other hand, once or twice it was noted that slight pressure or supporting the tumor by the hand lessened or relieved the vertigo. But it may be stated that, as a rule, when dizziness is complained of it is the result of those causes which produce increased blood-pressure, or determination of blood to the head, such as compression of the jugular veins, position, muscular exertion, mental emotions and so forth.

Again, it is possible for pressure upon, or forcible reduction of, the tumor to cause serious cerebral disturbance, amounting almost to compression, as is vaguely referred to in one or two records; but such is rare, and must be regarded as a very infrequent attendant.

Accompanying vertigo, although much less frequent, *pain* is sometimes met with, and finds expression chiefly in the form of headache. It rarely arises spontaneously, and when present is usually associated with increased tension of the tumor, or, in other words, increased blood-pressure; and in some instances it was only produced by direct pressure exerted upon the swelling. Pain localized in, or confined to the vicinity of, the tumor is mentioned in one or two cases.

The local symptoms are much more characteristic and reliable than the general or systemic ones above mentioned.

The most conspicuous point in the examination of the tumor is its *seat* or location, which, in a general way, is nearly always in the tract of the superior longitudinal or some other sinus, or adjacent thereto; and, consequently, the proximity of a blood swelling to the course of any of the cranial sinuses, especially if presenting obscure symptoms, should be suggestive of this variety of sanguineous formation. But, as naturally anticipated, its actual or anatomical situation is positively dependent upon the form or variety of the lesion. Thus it may be briefly stated that the *diffused* form the result of a rarefying osteitis, especially erosion or resorption of the skull by the Pacchionian bodies, is found in or near the median line on the upper and posterior part of the cranial vault, that is, on either side and along the course of the sagittal suture (in which position the glandule Pacchioni are in greatest numbers), at its junction with the lambdoidal, and even extending a short distance on each side along the latter suture.

In the second or *venous* variety the situation is again influenced by the special structures involved. First, if the growth be formed at the expense of an emissary vessel it will be located on that portion of the cranium where these exist, and particularly over the site of the parietal and occipital veins, which are the larger and most often implicated; Secondly, if a true varix sinus exist involving the coats of the longitudinal sinus, then the pouch is more frequently located over one of the fontanelles; whereas, thirdly, in involvement of the diploic system of vessels it is apt to be confined to the os frontis and ridges of the occipital bone, but particularly the forehead, in which localities the diploic structure reaches its most complete and highest development. In traumatic cases the location is governed, of course, by the portion of

the skull receiving the injury, but usually such forces are applied to the frontal and anterior-summit regions of the head.

The moderate *size* of the tumor together with the direct influence exerted over its volume by certain conditions, are noticeable features. Even when distended to its fullest capacity it is usually of medium dimensions, although several cases are mentioned where it attained the volume of a large apple; whereas when quiescent, that is when the swelling is relaxed or at its minimum enlargement, the growth is quite small and sometimes scarcely perceptible if not completely indiscernible.

These changes or alterations in the size of the growth are very characteristic, and can be seen and felt to take place under those conditions affecting its distension and relaxation: the tumor slowly rising and swelling up in the dorsal decubitus or any position with the head lowered; by interference with the proper return of venous blood from the interior of the cranium, as in compression of the jugular veins, forced expiration, crying, coughing, sneezing, and the like; occasionally by a full stomach, muscular exertion, or mental emotions; and, rarely, during the normal respiratory effort; however, under converse influences or those conditions lessening or reducing expansion or dilatation, the tumor recedes gradually to a lower level, and often entirely disappears.

The *color* of the swelling in most instances is normal and does not differ from that of the healthy skin, but this may be materially influenced by the consistency or thickness of the tegumentary coverings, and may also vary with the degree of distension of the tumor. Thus, when the walls are very thin it may assume constantly a purple or violaceous hue, or again the discoloration of the walls may be recognized only during distension, and fade away to a natural color with the relaxation of the tumor. Furthermore, changes in its color may be the result of

coexistent disease of the skin of the tumor itself, namely, of a nævoid character, as was noted in several cases; but such a complication is infrequent, and when it does occur may be looked for, everything being equal, in congenital in preference to the other classes.

The influence of *head posture* on the volume and resistance of the tumor is so apparent to both the touch and eye that, manifesting itself as it does always, perhaps, in this affection, the symptom of *dilatation* and *reduction* produced thereby may be reasonably regarded as a pathognomonic character. Without an exception, I believe, this effect of position was decided and marked,—the tumor being felt to attain its maximum volume when any position with the head lowered was assumed, and even simply bending the head forward producing very evident increase of size and tension; whilst the reverse attitude, with the head fixed and erected, being attended by a diminution in both resistance and bulk.

Similar results are produced by *compression of the jugular veins*. This was employed in a number of instances, producing unequivocal impression upon the growth, and its influence may be taken as a rational symptom, and one of special value when associated with additional evidence; for, it is needless to remark, its range of applicability is much too wide and extended to be alone of diagnostic import in this type of sanguineous tumor of the skull.

Probably next in importance to postural influence (in the pouch-variety) may be regarded the symptoms of *compressibility* and *fluctuation*, which taken together furnish positive evidence of a fluid-containing pouch or cavity with an intra-cranial outlet. In all the cases of the pouch—or sac—form these symptoms were observed, and were among the chief distinctions—the swelling readily, and nearly always completely, but slowly subsiding under continuous lightly applied pressure with the hand or fingers, and tardily redilating upon the removal of the compress-

ing force,—and distinctly conveying to the touch the sensation of a sac filled with fluid, which was being emptied.

The rapidity and ease with which pressure accomplishes evacuation of the pouch is dependent, necessarily, upon the freedom and directness of the communication with the cranial cavity, but, as a rule, the reduction is rather slow and gradual.

Another symptom of considerable weight is the ability in many instances to recognize by the finger, after reduction of the growth, some *osseous alteration*, or even depression or indentation in the skull, corresponding to one or more openings leading to its interior, and which may be of considerable dimensions.

Furthermore, *puncture* by means of a trocar and canula with direct exploration of the bone, may disclose the existence of the aperture where it had eluded careful digital search. However, even such unsuccessful efforts to discover the communicating entrance should not be considered as conclusive evidence of its non-existence, for failure to detect the osseous perforation by this method occurred in several cases in which a subsequent incision or post-mortem examination demonstrated its presence.

The *sensation* or feel of the tumor-walls, as conveyed through manipulation, is to be taken into account in a description of the symptoms. In uncomplicated cases of the pouch-variety, especially the simple diffused form, after being emptied, the sensation is that of a loose, lax, movable covering of healthy skin tissue, of different degrees of thickness according to its constituents; whereas if partaking of aneurismal qualities, that is, with fibrinous depositions on its interior surface, these are recognized as usually irregular but firm or solid masses occupying the substance of the walls, or, perhaps, the cavity of the growth. In the varicose-type there is readily discernible after evacuation or reduction of the swell-



ing, a spongy mass or substance, varying according to the character of the varicosity, but which nearly always remains as an irreducible structure between the fingers.

*Pulsation* and *bruit* require notice only because they are mentioned as occurring in several cases. They are to be regarded in the light of extremely rare accompaniments, and practically must be entirely eliminated from the list of symptoms. When met with they are explicable on the ground of contiguity to the cerebrum and a dural sinus or artery.

Finally, a symptom of no indifferent significance is that attending the employment of *circular compression*. This constriction may be applied either to the head, by means of a band or cord tightly drawn around the cranium with compresses in the temporal fossæ, or to the tumor itself, as by a ring or similar apparatus closely encircling the base of the growth. By this means the external or superficial venous blood current is largely separated from the internal or intra-cranial venous circulation, and the subsequent manipulation of the growth now enables one to decide from which system of veins the blood supply is derived.

The method was employed quite a number of times, and in each instance fully demonstrated its utility and importance as a diagnostic measure.

#### DIAGNOSIS.

In uncomplicated cases, the history of the lesion, its location, want of marked elevation, and slow progress; the usual normal color and texture of the integument of both the tumor and adjacent surface; the positive influences of posture coupled with those resulting from pressure of the jugular veins; compressibility of the growth—its easy and usually complete but slow evacuation; frequent fluctuation; the recognition by the finger or exploring needle of bone alteration; and very often of perforations in

the cranium; the absence of bruit and pulsation; the effect of the application of a circular compression; vertigo produced by certain positions and movements; and lastly, the demonstration by puncture of the presence of venous blood filling the tumor, constitute a symptom-group scarcely to be misinterpreted. Hence, as a rule, the diagnosis should not offer specially confusing or obscure features.

There are, however, a number of lesions presenting symptoms in common with this formation, which might claim consideration in a nice or accurate differential diagnosis, and, therefore, the principal of these affections call for a brief reference:

Thus a certain degree of resemblance is borne to (1) meningocele and (2) encephalocele, or (3) superficial nevus coexistent with these; (4) cephal-hæmatoma; (5) simple subcutaneous venous erectile or vascular tumor (including, possibly, the capillary variety); (6) lymphatic vascular tumor; (7) certain cystic tumors; (8) venous aneurism; (9) rarely aneurism of the middle meningeal artery associated with bone erosion; (10) fungus of the dura mater; (11) pneumatocele; (12) traumatic cephalhydrocele; and, under rare circumstances, (13) circumscribed abscess, especially where skull perforation has taken place.

In those instances, however, where an individual case offers specially confusing difficulties, or, at least, where questionable points prevent a definite conclusion, the demonstration of a tumor containing fluid, completely or partially reducible under lightly applied pressure without producing cerebral disturbance, directly influenced by posture and circular compression, and of which puncture or aspiration shows the fluid to consist of living venous blood, would be quite sufficient, against otherwise doubtful symptoms, to confirm the diagnosis.

## PROGNOSIS—PROGRESS.

Analysis of the cases collated shows that, this class of sanguineous tumors if left to nature and not disturbed by treatment, does not incline to a fatal termination; and, therefore, the prognosis may be looked upon as favorable in all the types of the lesion as far as life is endangered or even serious impairment of health is concerned, and, indeed, spontaneous cure is said to have resulted in one recorded instance.

Where, however, surgical interference is resorted to with the view of a radical cure or permanent resolution of the growth, then the prognosis becomes of very different import—assuming an important, if not serious, phase—and being materially influenced by the special type or variety of the tumor involved, with also the particular operative method adopted.

In the large majority of those instances where no active surgical treatment was employed, and which were kept under observation for a longer or shorter period, there was not only no marked change in the attending symptoms, but the progress was noticeably slow—there being but little tendency evinced to extension or any decided change whatever. Thus, in illustration of the general stationary tendency of these tumors after a certain size is attained, it may be mentioned that of twelve cases, embracing all the classes and the several types, which were followed up, eight were noted as remaining unchanged after five, twelve, fourteen, twenty, forty, forty-three, forty and seventeen years, respectively; and in the latter instance the growth disappearing spontaneously after a long examination, including repeated palpations. But in two other instances moderately rapid growth was reported,—in one of which the progress being slow for twelve years, and then in the succeeding four years rapid increase took place, with the development at the same time of a second tumor or sac communicating with the first.

Whereas, on the other hand, among seven patients

upon whom operative measures were practiced, comprising free incision, strangulation by ligature of the base, the actual cautery, and electro-puncture, there were four deaths, two each from immediate hæmorrhage and suppurative phlebitis with meningitis. The three successes which resulted were respectively from strangulation by ligature, incision, and electro-puncture. It must be referred to, also, that the two cases of M. Azam were unaffected, apparently, in their symptoms and progress by the repeated punctures of the pouch which were practiced for diagnostic purposes.

#### TREATMENT.

Notwithstanding the fact that *palliative* or protective measures have received the strong endorsement and recommendation of the larger number of writers upon this subject, and by some is regarded as the only treatment to be adopted (v. Gross, Dupont, and others), and although almost universally employed, with but few exceptions, in the collected cases, the histories of these prove that such methods exercise hardly any, if, indeed, not being wholly without appreciable, effect over the progress or course of the affection, and hence must be declared not only fruitless, but, in some instances, positively harmful.

This can scarcely serve as a matter of comment when the anatomical and pathological characters of the lesion are considered, and, therefore, beyond the mere statement of the results of palliative treatment, this portion of the subject does not demand further consideration.

Measures having a radical or *curative* object in view, were of two forms, namely, direct compression of the growth, and certain operative procedures.

The former, or the application of *direct compression* to the tumor, occupies a very similar position to that of palliation, as far as exerting any retarding or inhibitory influence over the course of the disease;

and, at the same time, on account of the effect produced in several trials of the method, it should be regarded also in the light of a dangerous or hazardous operation when indiscriminately employed, and especially so in certain varieties of the lesion. Thus, in a case of probable varicose emissary veins, M. Azam punctured the tumor and practiced steady and continuous pressure for twenty days, but not the slightest benefit whatever was obtained, and the patient was dismissed in an unchanged condition.

Hecker applied compression for a considerable time without effect, in a case of frontal diploic tumor with loss of osseous tissue; continued and carefully regulated pressure proved equally useless in the patient of Nèlaton and Richard; and the efforts of Hutin to cure by compression, with leaden and silver plates, a blood-pouch resulting from cranial fracture and accompanying sinus-wound, were likewise ineffectual. Again, Dubois, in a case of frontal tumor, probably of the diffused variety, first attempted compression by bandages, but without benefit or change; then later forceps-pressure was employed for forty-eight hours, but such excessive pain associated with cerebral symptoms of an ominous character, and decided reactive or inflammatory changes both within and without the sac, were provoked, that the attempt was necessarily abandoned. This was also devoid of beneficial result.

In Verneuil's patient spontaneous subsidence of the growth took place after repeated and prolonged handling and palpation of the tumor. Such manipulation should be reckoned as a form of compression, but in this instance the observation loses its value because of the inaccuracy of the history, failure to follow up the case for a sufficient length of time, and the consequent doubts expressed by the reporter himself.

The nature and extent of the *operative* interference employed, are represented by the following methods,



viz.: free incision, and incision combined with cauterization; constriction or strangulation of the base; the actual cautery; and electro-puncture.

The operation of laying open the tumor by *free incision* was resorted to in four instances.

Pott, mistaking a diffused form of the lesion following direct wound of the sinus from fracture in the person of a lad, employed incision and trephining with a favorable result.

In the case of an adult suffering from a growth composed of varicose venæ emissaria, Moreau divided the tumor directly across, and, in order to staunch the alarming hæmorrhage which ensued, he made frequent cauterization of the wound with antimony. Death took place on the fourth day from suppurative phlebitis and meningitis.

Flint's patient was an infant with a probable ectasia of the sinus through the fontanelle, in whom immediate dissolution from hæmorrhage was the consequence of an extensive incision.

The last instance is the patient of Hutin, who had an old blood-tumor of the cranial vault produced by injury. During a subsequent attack of erysipelas, in which he became unconscious, this swelling was taken for a pus collection and freely incised. Venous blood flowed abundantly, but pressure easily controlled it. Pleuro-pneumonia caused a fatal termination.

In two other cases of probable varicose emissaries, small punctures were made to aid diagnosis, but without observable effect.

There are two examples of constriction or *strangulation*. Mersemann's patient was an infant at the breast, with a venous tumor of the varicose type. Complete strangulation effected a cure. Foucteau encircled the base of a large tumor on the head of a child, which proved to be a sinus ectasia, with a stout ligature and then punctured the growth. A large quantity of blood was withdrawn, and the child suc-

cumbed on the following day, from hæmorrhage, he believes.

The *actual cautery* was employed by Michaud in a varicose formation. Erysipelas and meningitis followed the application, and death took place therefrom on the seventeenth day.

But one case, also, represents the use of electro-puncture. This was in an adult upon whom Bardelieben successfully punctured the tumor, which was probably a varicose formation, communicating with the longitudinal sinus.

Summing up the evidence furnished by these several cases of operation, it is seen that incision gives one cure in four, and that one being of the traumatic diffused form; strangulation gives one cure in two, the successful issue being of the varicose type; the only instance in which the actual cautery was employed—a case of varicose emissary veins—ended fatally; and the single use of electro-puncture in a similar form of the lesion was attended by gratifying results.

The causes of death in these cases brings up the question of the dangers to be apprehended from surgical or operative measure, and which may be embraced by phlebitis, attended by thrombosis and embolism, meningitis, septicæmia, hæmorrhage, air-embolism, and serious cerebral disturbances.

Phlebitis, meningitis and septicæmia are so closely connected in the present relation that they may be properly discussed under the same heading. From this cause two deaths took place out of seven operations, and therefore on this account and for apparent anatomical reasons such a danger assumes an important and just significance. This is furthermore borne out by well-known clinical examples, and also by the experiments of Schellmann (v. Bergmann, l. c.) who found that the chief danger resulting from sinus-wound was the formation and subsequent disintegration of the thrombus—leading to septicæmic infec-

tion. However, the aseptic management of wounds which characterizes modern surgical practice, associated with our increasing enlightenment concerning the tolerance of the venous system in general, and especially, in the present instance, the veins of the brain and its enveloping tunics, to operation wounds and accidental injuries, not only marks a great scientific advance in surgery, but has reduced in a wonderful degree the risks and dangers to be apprehended therefrom; and consequently revolutionized our ideas of the once dreaded inflammatory and septicæmic processes.

Although two fatal results are reported in our collection from immediate hæmorrhage, I cannot regard this danger from sinus-wound in the same light as it is evidently looked upon by many authorities. Wounds of the dural sinuses if extensive are, undoubtedly, attended by profuse and even alarming loss of blood, but the methods at our disposal for controlling such hæmorrhage are both trustworthy and easy of application.

Thus the efficiency of simple pressure in arresting hæmorrhage is exemplified not only in the special lesion under consideration by the cases of Pott and Hutin, with those cases which were simply punctured, in which pressure sufficed to permanently staunch all bleeding, but also in different injuries and wounds of the sinuses, as illustrated by the patients of Reid (*Edinburgh Med. Jour.*, April, 1864), Sands (*Annals of Anat. and Surg.*, vol. viii, p. 100, 1883), Hopkins (*Annals of Surgery*, July, 1885, p. 67), and other easily cited instances, and more recently by the experiments of Senn, contained in an admirable article on the subject of Air-Embolism, read before the American Surgical Association, April, 1885 (*S. Society Transactions*, 1885, also *Annals of Surgery*, June, July, August and September, 1885).

Numerous other authorities might be adduced in confirmation of the efficiency of pressure, but, be-

yond the additional mention of the paper of Hector Cameron (*Lancet*, May 24, 1884), in which is shown that in many, or the majority of, instances only the gentlest pressure is required to stop blood-flow from a wounded sinus, further citations would be superfluous.

If I have spoken in commendatory terms of pressure as a hæmostatic measure in sinus injuries, I believe that I am warranted in speaking in an equal, if not more positive, manner of the ligature and suture, especially applied laterally. It is true that Senn (*L. c.*), and he is not alone in this opinion, considers suturing the sinus (including, evidently, lateral ligature) as unreliable and in most instances anatomically impossible, but the successful instances where such measures were adopted are sufficiently numerous to justify my expressions of confidence in the proceeding; and, as furnishing clinical and physiological support to the practice, the experiments of Schellmann, already referred to, demonstrated the important fact that wounds of the sinuses heal without causing obliteration of the sinus,—the wounded wall becoming thickened in the reparative process but the lumen of the vessel remaining unobstructed.

Such successful employment of the lateral suture and ligature in the cases of Brinton (*Philadelphia Med. Times*, vol. xii, p. 577, 1881) and Parkes (*Annals of Anat. and Surg.*, vol. viii, p. 118, 1883), are by themselves adequate testimony of its practical application and reliability.

Proximal and complete double ligature of the sinus has been shown to be largely devoid of serious results, and calls for adoption when other less severe methods have failed or proved incompetent to meet the indications required.

Besides other important facts shown by Schellmann, he has indicated also, by both experiment and collated cases, that contraction in the calibre or even complete obliteration of the lumen of the large

dural sinuses need occasion no constant disturbance in the brain, but, on the contrary, that such obstructions may and do exist for an indefinite time without the manifestation of any grave cerebral symptoms. Additional evidence of the immunity with which these venous channels may be reduced or lessened in their calibre, is seen in the case of Parkes (*l. c.*), where the sinus longitudinalis was diminished at least one-third by lateral suture, and also that of Kuester (*Berliner Klin. Wochenschrift*, Nov. 14, p. 673, 1881), who, in the extirpation of a sarcomatous growth from the dura mater of the frontal region, successfully practised prophylactic double ligation of the exposed longitudinal sinus.

This subject of deligation of the sinus has been particularly studied by Senn, and, as a result thereof, he considers it a safe measure for the arrest of hæmorrhage, and believes that preliminary ligation will become an accepted procedure in the removal of dural and other tumors involving this structure. Certainly the subject is an important and interesting one, and with me fully maintains the feasibility of ligation of the sinus in specially severe cases of ectasia or hernial protrusion of the sinus-wall, and also of the diffused variety, demanding surgical action.

The aseptic tampon (Senn), cold (Abel), position, and styptic substances as means of arresting bleeding from this locality need not be discussed.

Air-embolus or aspiration of air into the sinuses is a danger which, although having but one known recorded instance of a fatal occurrence to demonstrate its possibility, namely, Volkmann's case (reported by Geuzmer (*Verhandlungen der Deutschen Gesellschaft für Chirurgie*, vol. vi, p. 32), must be recognized and borne in mind in all operations implicating these venous reservoirs; and, indeed, the assertion of Franck (*Sur la transmission de l'aspiration thoracique jusqu'aux canaux Veineux des os du Crâne, etc.*; *Gazette Méd.*, No. 25, 1881) that he has witnessed more



than once after trephining the entrance of air into the diploic veins, should admonish us that the so-called danger zone is not limited to the cervical region, and to exercise due precaution in dealing with all operations and injuries implicating the cranial tissue.

It is unnecessary to examine any farther this danger of air aspiration in these localities, and for more accurate information of the subject, generally I cannot do better than direct you to the literature of the entrance of air into veins, and in particular the valuable and elaborate paper of Senn, which has been already several times referred to and quoted from.

The occurrence of serious brain perturbations and disturbances attending operative measures upon the sinuses, rests almost entirely in an interference with the delicate equipoise of the cerebral circulation. This question has been clearly answered in the negative by the observations of Schellmann, and the cases I have referred to, to which may be now added the patient of Schüppel (*Ziemssen's Handbuch, Galle and Pförtner*, p. 324, mentioned by Browning, *l. c.*) in whom the superior longitudinal and both transverse sinuses were found obliterated by an organized thrombus, and with compensatory anastomosis.

In conclusion, after this brief sketch of the treatment of this class of sanguineous formations, I must express myself as favorably inclined towards curative operative measures—especially by the suture and ligature, electro-puncture, and strangulation of the base—in certain extreme instances, the particular method chosen to be governed by the type and form of the individual case involved.

#### RECAPITULATION.

As a result of the foregoing study the following summarized conclusions are reached:

1. Cranial venous blood tumors communicating with the dural circulation are to be classified into

three divisions, namely: the congenital, spontaneous, and traumatic.

2. These classes are divided, upon both anatomical and pathological grounds, into two species or varieties: *a*, the diffused, produced by a perforation of the cranial plates and the wall of the subjacent sinus, resulting in a limited extravasation of blood beneath the scalp and thus forming a blood-cyst in direct or immediate communication with the affected sinus; and *b*, the venous or vascular, in which the tumor is directly formed at the expense of the venous coats, and includes in its scope the sinuses, the venæ emissaria, and the diploic vessels.

3. The venous type is the commonest in point of occurrence, and of this type, varicose involvement of an emissary vein is the most frequent form; whilst the diffused is the rarest of all the varieties.

4. The diffused variety is especially characteristic of the spontaneous and traumatic groups. The venous or vascular type occurs most frequently in the congenital class, but at the same time is often met with in the spontaneous division.

5. The medium of communication with the intracranial circulation is, in the very large majority of instances, represented by the superior longitudinal sinus, particularly its central and posterior portions. The emissaria Santorini most often implicated are, probably, the superior or posterior parietal emissaries, which pair, also, are the most constant and uniform in their existence. When the diploë is involved the frontal region is the usual seat—no instance of a similar occipital formation having been observed.

6. In a causal relation, some morbid action in the venous walls is notably prominent in the congenital class; in the spontaneous group, atrophic or rarefying osteitis ranks first as a cause, and venous disease secondly; and in the traumatic division, direct injury, which nearly always means fracture, is the only etiological factor.

7. Palliative measures for retarding or arresting the progress of the growth, and certain forms of compression intended to act as a curative agent, are useless applications—the latter, in addition, being capable of producing alarming head symptoms, and hence may be harmful.

8. General surgical interference is not called for, because the history, nature, and progress of the lesion is opposed to indiscriminate operation; being of that character to render such treatment unnecessary. When, however, operation is deemed expedient or is demanded, the following methods seem to be open for adoption:

*First*, if the growth be either of the diffused type, or that form consisting of a varix-sinus, exposure and ligation of the pedicle (if such exist), or, if necessary, deligation of the sinus in its course, the trephine being boldly employed to furnish requisite space for the necessary attending manipulation. The lateral ligature and suture, when applicable, are preferred to complete ligation.

*Second*, if the tumor be composed of varicose emissary vessels, or, perhaps, of diploic dilatations, either electro-puncture or strangulation of the base are justifiable procedures, but preference is given to electro-puncture.

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